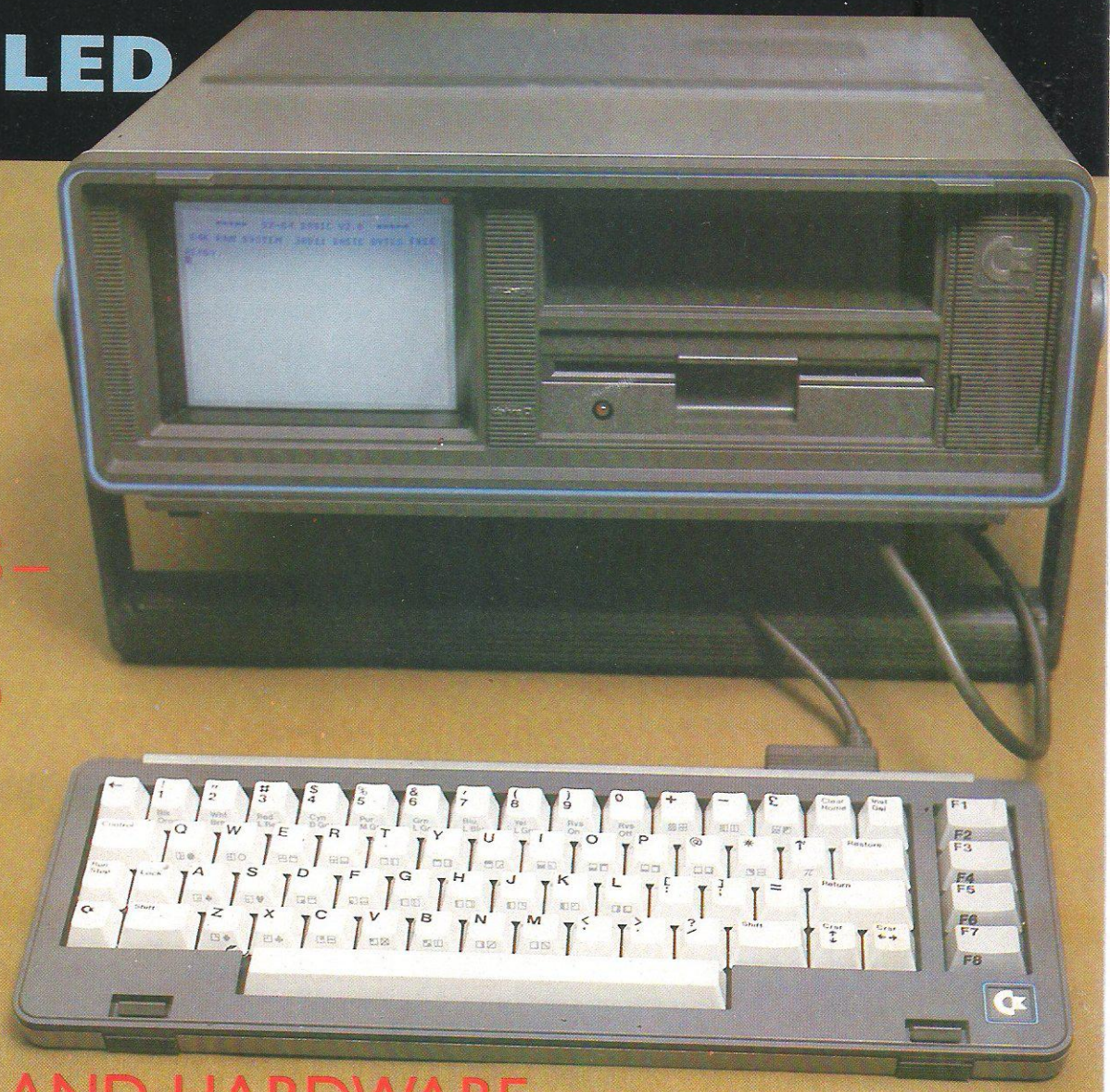
CANADA $4·50 USA $3·25 Vol 2 No 10 UK £1

COMMODORE

COMPUTING INTERNATIONAL

The Independent Commodore Magazine

SX-64 REVEALED



ROBOTS FOR YOUR MICRO

PROGRAMS – MACHINE CODE AND BASIC

PLUS

SOFTWARE AND HARDWARE FOR PET, VIC AND 64

BELGIUM FR130 FRANCE FR18.5 GERMANY 6DM

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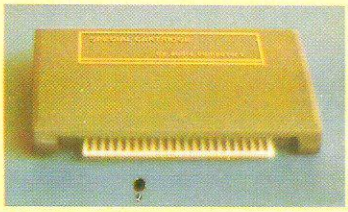
FROM AUDIO-COMPUTERS (SOLIDISK) THIS MONTH:

NEW LOW PRICES ON VIC-20 HARDWARE ADD-ONS AND THE INTRODUCTION OF NEW SOFTWARE CARTRIDGES

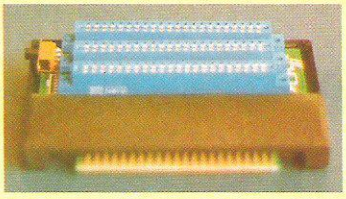
If you have already bought a memory cartridge for your VIC-20 computer, we still have many exciting items to offer, under the heading 'FURTHER EXPANSION'. They are perfectly compatible with all Commodore and many other manufacturers products.



NEW LOW PRICE ON 16K MEMORY CARTRIDGE:

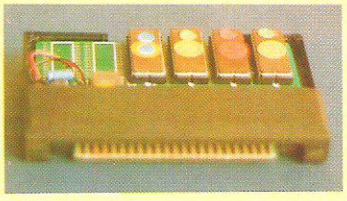
Any program sold for the VIC-20 with 8k or 16k extra memory will run with the SRC16.
The NEW PRICE of the SRC16 is now only £27.00, including VAT and manual.
It is important to know what else you can do with the SRC16 other than running big programs.
1) The SRC16 can be upgraded to 32k bytes of RAM at a fraction of the cost of a 16k cartridge. This upgrade costs only £11.00
2) The SRC16 has an X-ROM SOCKET. Games or utilities ROMs such as SCREEN ROM or SOUND ROM can be bought separately and used in this socket. Each software ROM costs around £5-10.00.
3) The SCR16 can have an EXPANSION SLOT built in. This important fact should be noted, since many VIC users experience fitting problems and extra expense when adding a Programmer's AID toolkit cartridge or the Machine Code Monitor Cartridge to their system. With many other low cost 16k memory cartridges, the user will have to buy a multi slot motherboard just to accommodate any extra cartridges. This feature alone could save you as much as £20! The SLOT is the exact reproduction of the expansion port into which the SRC16 is inserted and will cost you only £3.00. Right now you can choose any of the extra features to be built into your SRC16 cartridge. Simply tick the option boxes shown.

FURTHER EXPANSION TO THE VIC-20 COMPUTER:



1) 3 SLOT MOTHERBOARD:

for those for whom it's too late to buy a SRC16 cartridge or who want more than just memory. The 3 Slot MOTHERBOARD is not without special interest:
a) A Memory Select System allows the user to add the memory capacity of 2 RAM cartridges — for example, an SRC16 and a Commodore VIC-1111 can be used together to provide 32k bytes.
b) An optional 8k Memory System, very flexible, that will give 11775 bytes free or 6655 bytes free in the Low Res area or occasionally 8k bytes at $A000 to $BFFF for developing your own Autostart program can be added. Furthermore, if you then add your SRC16, you will get 28159 bytes free for your VIC 20!
c) 2 EPROM SOCKETS: this feature is very much appreciated by most users and has been added only very recently. You can use either 4k EPROMs (2732) or 8k EPROMs (2764) in these sockets. Each EPROM can be activated individually exactly as if you had 2 extra cartridges in your system!

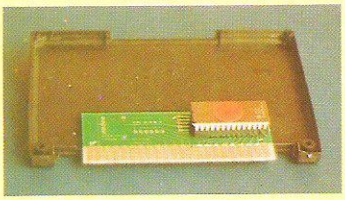


2) THE VIC EPROM PROGRAMMER: (uses 2764 Eproms)

We would need a whole page to describe this exciting peripheral for your VIC-20. Briefly, the cartridge works a little like a Disk. You can insert the VIC EPROM PROGRAMMER (VEP for short) into the SLOT and activate it with:
SYS 39000
On the VEP, you will find 4 EPROM sockets. Now type in 'C' to display the catalog. It will show what is in every EPROM. It could be like this:

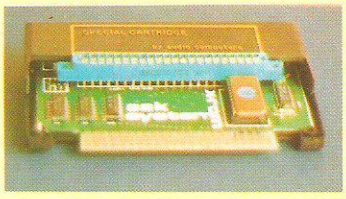
1. BIGBASIC	Simply enter 'R.1' to read the first program. You will instantly see:
2. UTILITY	*READING BIGBASIC
3. AUTOSTART GAME	*READING OK
4. BLANK EPROM	READY

Now you can list it, print it, run it etc. . .
The VEP does the loading of a 16k program in about 3 seconds with no loading error unless you have a bad RAM; it will then list out all the dead or missing bytes!
To put a program into EPROM, load it from tape or disk, activate the VEP and enter 'W PROGRAM-NAME' — very simple to do.
Other useful commands provided by the VEP include Hex Memory Display, Memory Change, Memory Fill, Memory Transfer, Save a Block of Memory, Load Tape, Cold Start, Centronics Printer Drivers etc. . .
You can put Basic, utility or autostart games onto Eprom in a similar way. The VEP will work out where your program is stored and will scan the EPROMs to find enough space to put it.
You can also use it as a self contained Eprom programmer to program, verify and copy Eproms.
Utility and Autostart EPROMs made with the VEP can be used on our Motherboard or on our BLANK SOFTWARE CARTRIDGES and used as any software cartridges.
We supply a small manual together with the VEP showing how you can write an Autostart program, in Basic and in machine code. We will also supply you with a free Blank EPROM and a free Blank Software Cartridge to get you started.
A word of warning: we have developed this equipment to help users in materialising sellable software (we are very keen to buy) and will disclaim any illegal use of it.



SOFTWARE CARTRIDGES

(insert directly into back of VIC, into Motherboard or SRC slot).
1) SCREEN CARTRIDGE: Sets the screen size within limits as small or large as you like. You can for example set the screen to 40 lines × 80 columns and a 'window' of 25 lines × 30 columns, write a letter or draw a colourful playing board and move your window with control keys or joystick. As you are typing in, the window will move along to accommodate. Basic programs can be typed in, listed and run even in 80 column format. Price £10.00.
2) SOUND CARTRIDGE: transforms your VIC into an electric organ. You can play music with the keyboard, add a second voice when it plays the 1st, a 3rd when it plays back the 1st and 2nd etc, define ENVELOPE to create effects like wailing police siren, play music within basic program without slowing the speed of Basic. In short, the sound Rom makes the VIC as tuneful as the BBC micro or the ATARI. Price: £10.00
These 2 cartridges are also available in chip form. You can use the chips in the Motherboard or in the X-ROM socket of your SRC16. Price: £8.00 for either of the 2.
3) MORE CARTRIDGES will be released. We would like to market your programs in cartridge form. Alternatively, we can supply blank cartridges at very competitive prices for commercial use. We are just a phone call away so if you have a good idea, why not give us a ring?



SUMMARY	PRICE/U INCL. VAT
SRC16	£27.00
OPTIONAL EXTRAS FOR THE SRC16:*	
UPGRADE TO 32K	£11.00
EXPANSION SLOT:	£3.00
FURTHER EXPANSION:	
3 SLOT MOTHERBOARD:	£19.95
OPTIONAL EXTRA 8K FOR MOTHERBD*	£16.00
VIC EPROM PROGRAMMER (+ free gift)	£39.00
EXTRA 2764 BLANK EPROM:	£6.00
BLANK SOFTWARE CARTRIDGE:	£3.00
SOFTWARE CARTRIDGES:	
SCREEN CARTRIDGE:	£10.00
SCREEN ROM ONLY:	£8.00
SOUND EFFECT CARTRIDGE:	£10.00
SOUND EFFECT ROM only:	£8.00
Post and packing:	£1.00
TOTAL:	

*I enclose a cheque/postal order payable to SOLIDISK LTD for £:
*Please charge my Access/Barclay credit card account No:
(*Please delete/complete as applicable)

.....

Signature

Name: Mr/Mrs/Miss: .....

Address: .....

.....

.....

Please note: optional extras cannot be purchased alone. Also, if you wish to purchase them at a later date, SRCs and Motherboards must be returned together with the appropriate payment + £1 P+P. We regret we cannot accept orders of less than £10.00. All prices include VAT at 15%. Europe: deduct VAT, add £3.

Official UK dealers:
SUMLOCK, Manchester, Norman DAVIS, Mill Hill, GODFREY'S, Basildon, CURRY'S MICROSYSTEM chain store.

Official European distributors:
Benelux: ECD, Delft Tel 015 134429.
France: RUN informatique sarl, Paris Tel (01) 581 5144.
Germany: VOBIS Data computer GMBH, Aachen Tel (0241) 50 00 81.
SCHAEFER, Roetgen Tel (0240) 88 319.
Italy: SOLIDISK Italia, Inglesias (CA), Tel 0781 22529.
Portugal: LANDREY Engineering, Lisboa Tel 681243.
Sweden and Norway: DIGILOG, Goteborg Tel 031 20 29 00.

Thank you for the interest shown. Marketing Manager: H. PERRY

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(T/A AUDIO COMPUTERS)
87 BOURNEMOUTH PARK ROAD
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ESSEX SS2 5JJ UK

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COMMODORE COMPUTING INTERNATIONAL

MARCH 1984

COVER STORY

The SX-64, Commodore's new portable version of the 64, is put through its paces in this issue.

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THE INTERNATIONAL VIDEO GAME OF THE YEAR COMPETITION HERALDS THE "NEW AGE" IN VIDEO/COMPUTER GAMES

$175,000 TO BE WON

International Video Game of the Year

Create a brilliant, new video game and you could be on your way to becoming a millionaire. This fantastic competition, organised by I.R.P. (The International Register of Independent Computer Programmers Ltd) and the famous Mark McCormack International Management Group, offers programmers and inventors the opportunity of a life time. There are huge, immediate cash prizes and the on-going revenue of 10% of the sales of all games to distributors throughout the world, plus the chance to appear on an international TV show. Your skill and imagination could bring you fame and fortune!

$100,000 FIRST PRIZE! PLUS FIVE $15,000 RUNNER-UP PRIZES!

Devise a totally original new video game in one of these categories: SPORTS, SIMULATORS, ARCADE, STRATEGY, ADVENTURE/FANTASY or a special section which covers programmes that are not necessarily games but have outstanding Educational or Entertainment merit. We'll also be announcing a number of 'MERIT' awards which will be entitled to carry the message 'An International Video Game of the Year MERIT AWARD' on their retail packaging. It's a great challenge. And the rewards, both financially and in terms of prestige, are tremendous. This is the most exciting competition ever for creative computer and video enthusiasts.

YOU'RE A TV STAR TOO!

All six winning games and their inventors will be featured on an internationally distributed, spectacular TV special. That's going to make your name!

HOW TO ENTER

Just send in your game, or games, programmed on cassette for any popular home computer. Use the coupon, today, and we'll send you all the facts you need.

CLOSING DATE FOR ENTRIES IS 31st MAY 1984

To: **IRP Limited, Pinewood Film Studios, Iver, Bucks, England.**

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Address .....

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Record sales as Tramiel quits

Just days after Commodore announced record worldwide sales for this calender year, the resignation of Jack Tramiel, founder and Chief Executive of Commodore was announced.

He will be succeeded by Marshall F. Smith, president and chief executive of Thyssen-Bornemisza Inc who took up the post on February 21, 1984. Mr Smith is known to be an excellent businessman and has a history of successful management in industries both in the USA and Europe.

Worldwide, Commodore sales went up to $1 billion this calender year compared to $50 million seven years ago. Commodore (UK) contributed substantially to this and in 1983 they sold over 750,000 computers.

Jack Tramiel's long career with Commodore has seen phenomenal expansion and he will continue to assist the company as a consultant and adviser.

Six new games from America have been imported into the UK by Centresoft. Zaxxon, Pooyan and O'Riley's Mine retail at £14.95 and the other three are selling for £9.95.

Pirate threat to software

It is estimated by the British Guild of Software Houses that for every single game sold, up to ten pirate copies are made. An estimate that is increasingly worrying software publishers, especially as the value in lost sales amounts to at least £100 million!

Most of the 300 or so British software houses are hit by this illegal competition and stand to suffer losses, so plans are afoot to devise ways of combating the problem.

For further information **contact** Nick Alexander, Virgin Games. Tel: 01-221 7535.

Debut for Mycomp

A personal computer show, called Mycomp, is being held on November 1-4 in the Fulcrum Centre, Slough. Organised by Swan House, the Slough Corporation and the centre itself, the show is hoping to attract schools, families and businessmen.

Contact: Steven Mindel, Thames Meadow, Walton Bridge, SHEPPERTON, Middlesex. Tel: 0932 243866.

Wanted

Now is the chance for whizz kid computer game inventors to prove themselves. K-Tel, following the success of their initial launch into the computer software market, are looking for more ideas.

They are especially interested in games for the Commodore 64 and are looking for inventive, original and fun ideas. The best games will be selected for marketing. Interested parties should **contact** Mike Dixon, K-Tel International, 620 Western Avenue, LONDON W3 0TU. Tel: 01 992 8055.

Camps compute

Parents anxious to introduce their offspring to the computer world should consider Camp Beaumont. Courses are designed for complete beginners as well as the eager expert and are supervised by professional staff.

Courses in the curriculum include Logo, Basic for Beginners, Intermediates and Advanced programmers, Machine Code, word processing etc. A number of sports and other recreational activities fill the gaps between computer classes.

The Camps are based all around the country and the prices range from £58 for 3 days to £118 for 7 days. Both prices exclude VAT.

Contact: Beaumont Computer Workshops, 73 Upper Richmond Road, LONDON SW15 28Z. Tel: 01-870 9866.

New HQ

Recent expansion has prompted Intelligence (UK) to move from their Wimbledon Offices to Network House, Ariel Way, Wood Lane, London W12.

Join the club

Two new Commodore user clubs are the Wigan and North Gloucestershire Computer Clubs. They are both oriented to Commodore products; Pet, CBM 64, Vic 20 and their peripherals. In the very near future, Commodore Computing International will be publishing a special feature on Commodore clubs in the UK and elsewhere and welcome any information people have on their own clubs.

Contacts: NORTH GLOS CLUB, RC Harvey. Tel: 0242 527588 and WIGAN CLUB, AF Owen. Tel: 0942 212662.

Cross compile

Cross Compilers for the CBM 64 and the 700 are now available from Oxford Computer Systems. The cross compilers enable programmers to generate object and source codes on the 8000 series from the CBM 64 and 700 series respectively.

For the 700 series, the two products involved are the B-port, a version of Petspeed and the X-700, a version of the Integer Basic Compiler. Both are supplied on disk, retailing at £450 each.

The two cross compilers for the CBM 64 are the Portspeed, a suite of programs and the X-64, an integer compiler. Both are supplied on disk, retailing at £150 each.

Contact: Oxford Computer Systems, The Old Signal Box, Hensington Road, Woodstock, OXFORD OX7 1JR. Tel: 0993 812700.

Micro music

Musically-minded 64 owners will be interested in the full size keyboard, retailing at £130 + p&p from Autographics Ltd.

No external power is needed for this 4 octave C-to-C keyboard. It has two user definable sliders and an expansion slot allowing for developments. The controlling software is menu driven and simple to use, giving the user complete control of all Sid Chip parameters. Envelope Parameters are graphically represented and sounds can be recalled and stored.

For use with a cassette or disk and additional programs are available including sequencing and tuition.

Contact: Autographics Ltd, 3A Reading Road, HENLEY, Oxon, RG9 1AB. Tel: 0491 575469.

SX-64 arrives

The Commodore SX-64 portable, the executive version of the 64 is now available in the UK. Aimed at the businessman, salesman, and anyone who has to travel, it costs £895 including four free software packages.

The SX-64 can be transported and set up any where with a mains power outlet. Incorporated into the set is a 5 inch colour monitor, a 5¼ inch floppy disk drive and the detachable keyboard doubles as a lid. Commodore claims that it could be used in the 'home', but although it has a port for paddles, joysticks, lightpens etc it has no cassette interface.

Demand for this product has outstripped its supply, but Commodore are flying them over from the USA on a monthly basis.

High score competition

Livewire have produced three new games; Gridtrap, Jumpin Jack and Triad for the CBM 64, costing £8.95 each.

A 'High Score Competition' Entry form comes with each game giving players an extra incentive to score points. Any claim should be submitted with the form for validation. First prize is a Commodore 1541 Disk Drive. Second prize is a Commodore 1520 colour printer plotter. Third prize is a Simons Basic package and the seven runner-up prizes are pro-ace competition joysticks. The closing date for the competition is March 1 1984.

The three games will appeal to all age groups and 3D dimensional graphics have been used to inject the games with new perspectives. In October of this year Sumlock will be introducing the Pro Ace Joystick designed for the Vic 20 and CBM 64. Costing £12.95, its 2 year warranty is some indication of its reliability.

Contact: Sumlock Microware, 198 Deansgate, Manchester M3 3NE. Tel: 061-834 4233.

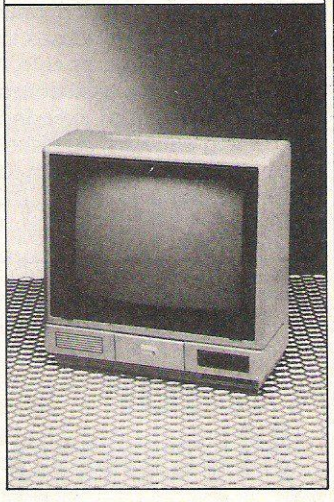
Supercat info

Two catalogues specialising in electronics, industry and research in general have been issued free by Supercat Electronics Ltd.

The January issue of the Electronics catalogue covers measuring instruments, leads, connectors, accessories and kit among other things. The direct mail catalogue deals with Multimeters, Oscilloscopes, Meggers and much more. The next issue will be coming out in the summer.

Contact: Supercat Electronics Ltd, PO Box 201, St Albans, Herts, AL1 4EN. Tel: 0727 62171.

First timer



Micro Peripherals Ltd have brought out what they claim is the first all-in-one British built colour monitor – the CM14 for £199.

The 14 inch colour monitor is compatible with Commodore machines and can receive RGB, RGBY, PAL COMPOSITE and audio signals.

Contact: Micro Peripherals Ltd, 69 The Street, Basing, BASINGSTOKE, Hants. Tel: 0256 3232.

More than fun and games!

CAESAR THE CAT

by Andromeda Software

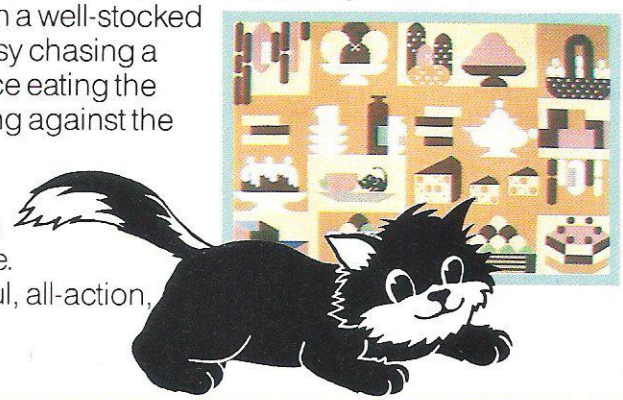
You will have more than fun and games when you meet Caesar, a cheeky young cat on duty in a well-stocked larder. He's kept busy chasing a gang of hungry mice eating the family's food. Playing against the clock, you guide Caesar along crowded shelves to pounce on the mice.

A fast, colourful, all-action, arcade-style game which is winning praise from reviewers.

'A marvellous, truly addictive game which also manages to be original, it has few peers.' ***Popular Computing Weekly***

'It's not possible to compare this game with anything I've seen before . . . Excellent.' ***Soft***

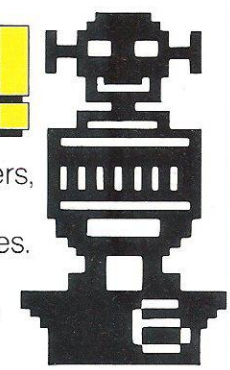
'Lovely graphics, and a fine entry into the market from Mirrorsoft.' ***Which Micro***



There's catchy music and a best-score record. Caesar the Cat is a challenge for high-scoring arcade addicts (has anyone reached a score of 10,000 yet?) as well as great fun for the novice.

Available on Cassette for the Commodore 64.

QUICK THINKING!



by Widgit Software

Two mind-stretching, space-age games to test mental arithmetic and nimble fingers.

In **Sum Vaders** alien robots invade the earth. Only quick thinking and fast reactions can prevent them. Several levels of difficulty and a two-player game with a handicap option make Sum Vaders equally testing for all family members, from 8 years to adult.

Robot Tables challenges the young player to make a series of perfect robots. With a learning mode and a testing mode this game is a fun way for early learners, and more advanced children, to master their multiplication tables.

Available now on cassette for the Commodore 64 (and also the Spectrum 48K, BBC B and Electron).

MIRRORSOFT programs are available from selected branches of W.H. Smith and Boots, and other leading software stockists. Trade enquiries welcome: phone 01-822 3580.

MIRRORSOFT

SOFTWARE FOR ALL THE FAMILY

To MIRRORSOFT, PO Box 50, Bromley, Kent BR2 9TT
Please send me the following (enter number required of each item in the space provided):

	Price	Spectrum 48K (01)	BBC B (03)	Electron (04)	CBM 64 (05)
Quick Thinking (QT01)	£6.95				
Caesar the Cat (CC01)	£8.95				

Prices include VAT and post and packaging.

I enclose a cheque/PO for £.....made payable to "Readers' Account: Mirror Group Newspapers Ltd".

I understand that my remittance will be held on my behalf in the bank account named above until the goods are despatched.

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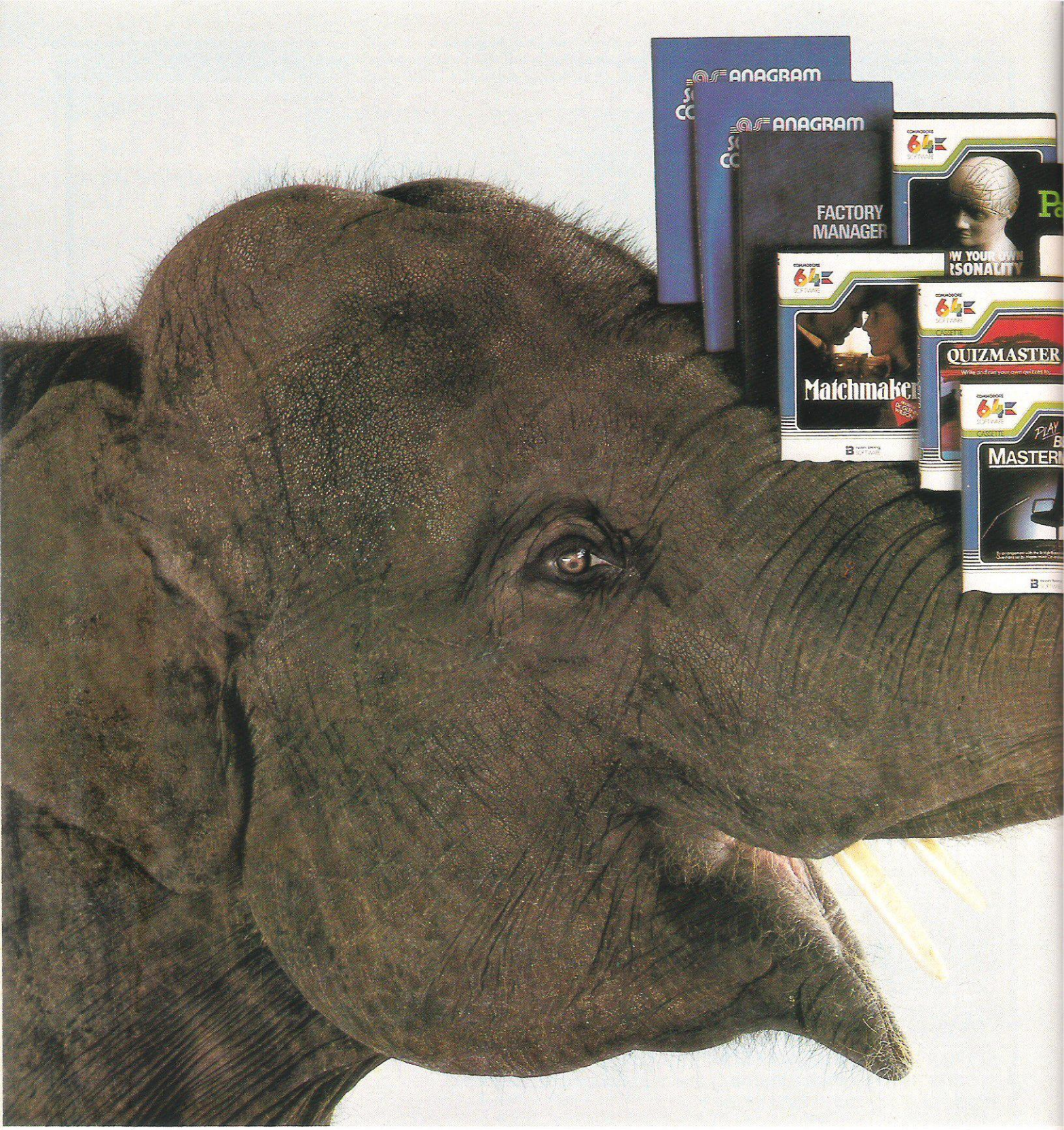


The problem with many home computers is there's often very little software to go with them.

Or all that is available is games, games and more games.

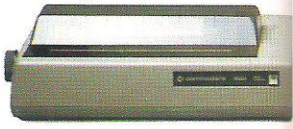
There's no such problem, however, with the Commodore 64. It has a more extensive range of serious software than any other home computer.

It also has an unusually large (in fact elephantine) 64K memory, as well as every peripheral you're ever likely to need.

All of this means you can run more interesting, entertaining and complex programs.

You can teach yourself many different subjects, even computer programming. There are programs for the office and, when you're mentally exhausted, yes, there are even games.

However, we have to admit that in one respect the Commodore 64 does fall short of the competition. It costs around £229, much less than any comparable machine.



And that's one fact we hope you'll never forget.

When you have an enormous memory there's no end to the things you can do.

Please send me further information on: the 64 computer ☐ 64 software ☐ disk drive ☐ cassette unit ☐ printers ☐ monitor ☐

Name (Mr. Mrs. Miss)

Address

Send to: The Commodore Information Centre, 675 Ajax Avenue, Slough, Berkshire SL1 4BG. Or telephone (0753) 79292.

commodore

6SCIC0384

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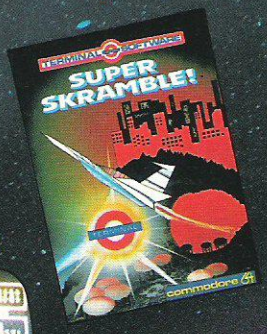

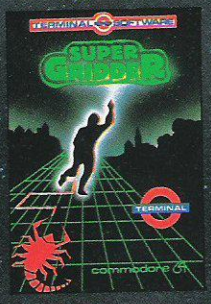

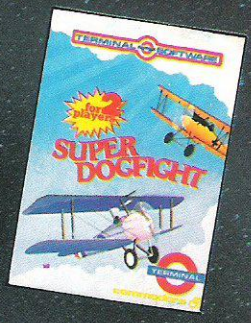

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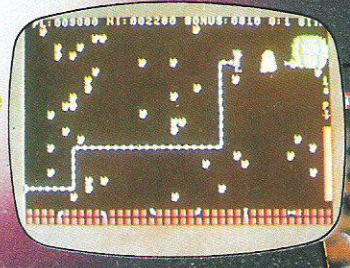

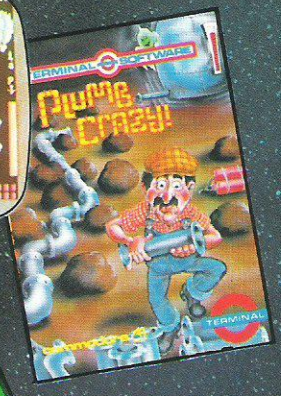

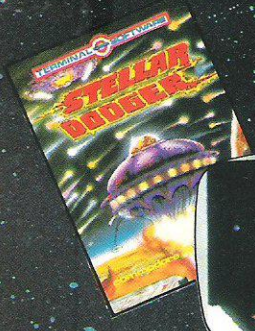

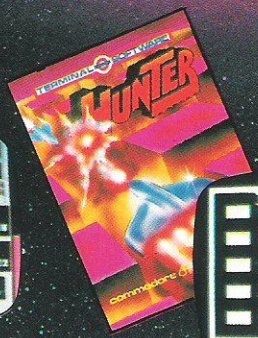

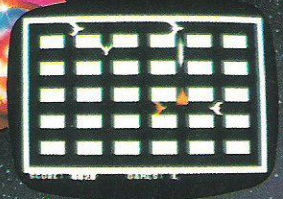

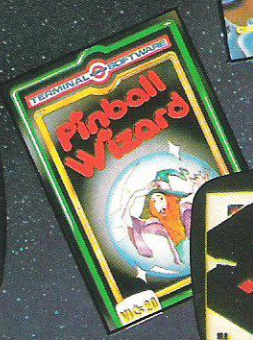

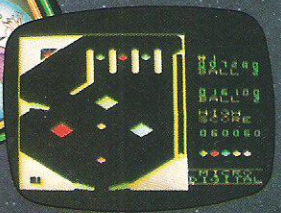

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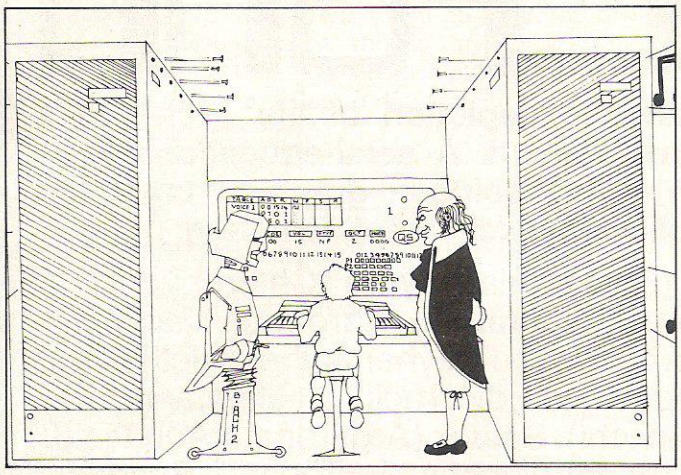


Aspiring musical composers will welcome Ultisynth 64, Quicksilva's new music processor. Priced at £14.95 the package includes an instruction manual.

Musical programs can be composed note by note and all the sounds of the orchestral instruments can be synthesised – piano, strings, woodwind, percussion etc. These can be played alone or together. For dramatic effects trains, thunder, flying saucers can be added.

Special features include four wave forms, modulation, synchronisation, editing facilities and three voices.

Contact: Quicksilva Ltd, 13 Palmerton Road, SOUTHAMPTON, Hampshire SO1 1LL. Tel: 0703 20169.

Education offensive

Commodore has launched a campaign to monopolise the hotly contested Education market. By offering computer systems with substantial discounts to schools they hope to present themselves as the viable alternative to other products.

This move coincides with the end of the Governments assisted purchase scheme which encouraged schools to introduce computers (what a coincidence!).

The package comprises the CBM 64, 1541 single floppy disk drive, LOGO (an advanced computer-aided instruction language) and Simons Basic 1 (programming aid). They are offering it to educational establishments for £299.99, a saving of £170. The offer is open until April 30, 1984.

Contact: All approved Commodore dealers in the U.K.

Hunchback

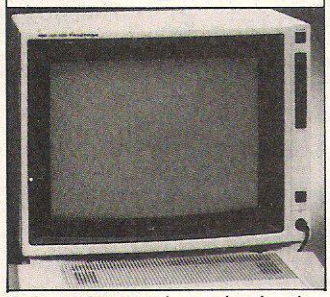
'Hunchback' the popular arcade game has been released by Ocean Software Ltd in program format for the CBM 64. Retailing at £6.90 it can be played with a keyboard or joystick.

The game has fifteen levels of difficulty and Quasimodo's aim is to rescue Esmeralda from imprisonment in the castle.

Contact: Ocean Software Ltd, Ralli Building, Stanley Street, MANCHESTER M3 5FD.

Tel: 061 832 9143/7049 and all major software outlets.

Sony TV



Sony have launched the KV1430, a 14 inch colour television specially designed for use with the home computer, retailing at £249.

The computer unit can be plugged into the RF socket on the front of the set and linked directly to the TV screen providing an instant connection for games etc. Vertical styling of the screen enables easier viewing.

The KV1430 is available from Sony dealers all over the country.

Petcomm

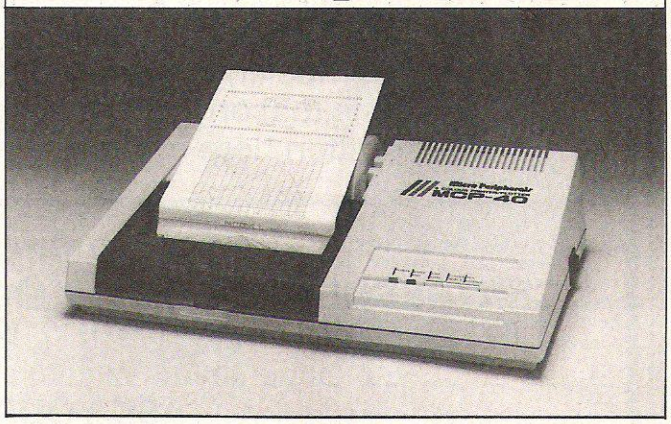
The Petcomm launched recently by Cortex Computer Systems Ltd enables one PET to communicate with another on a local or remote basis.

The package provides facilities for simple file transfer; error checking; file existence and disk capacity checking; relative and sequential file handling and file editing. The Petcomm is suitable for both floppy and hard disks.

Three versions are available; the Starter Kit retails at £970 and contains an operating manual, a 12 month warranty, 2 floppy disks and 2 interfaces. In addition there is the add-on package for existing Petcomm users at £695 and a second configuration with software costing £265.

Contact: Cortex Computer Systems Ltd, Cortex House, 5 Union Street, BEDFORD MK40 2SF. Tel: 0234 217721/2.

Printer/plotter



A printer/plotter, the MCP-40 has been designed by Micro Peripherals Ltd for the home computer. Priced at £113 excluding VAT.

By interfacing the MCP-40 to the CBM 64 the plotter can print out graphs and charts in four colours. It has a 80 column capacity and a printing speed of up to 12 characters per second.

Contact: Micro Peripherals Ltd, 69 The Street, Basing, BASINGSTOKE, Hants. Tel: 0256 3232.

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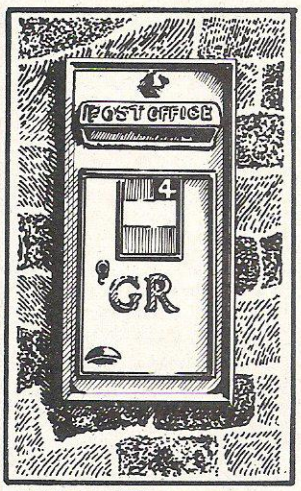

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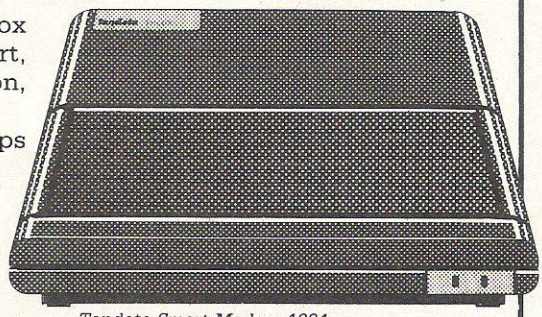

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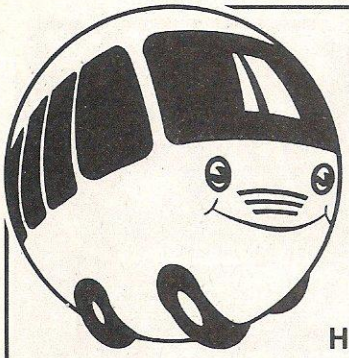

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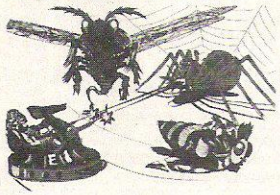

Definitely one of the best arcade action games around for the 64. Shoot the worm and everything else in the garden whilst avoiding the deadly spider and swooping eagle. Machine code using high resolution and Sprite graphics with excellent sound. Beware, it's very addictive.

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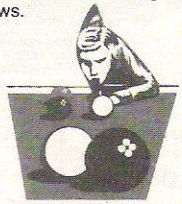

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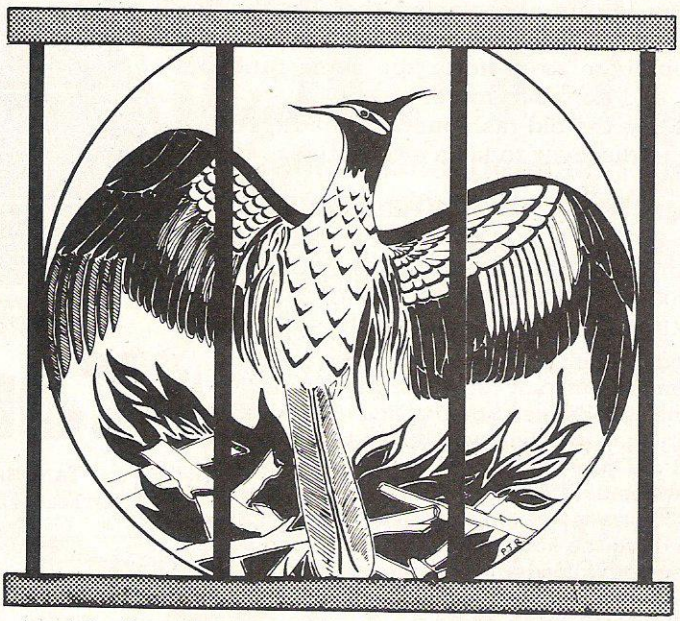

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"**Colossal Adventure** is included in Practical Computing's top ten games choice for 1983: "Poetic and tough as hell." *– PC, Dec 83*

"To sum up, **Adventure Quest** is a wonderful program, fast, exciting and challenging. If you like adventures then this one is for you" *– NILUG issue 1.3*

"**Dungeon Adventure** is recommended. With more than 200 locations, 700 messages and 100 objects it will tease and delight!" *– Educational Computing, Nov 83*

"**Snowball** . . As in all Level 9's adventures, the real pleasure comes not from scoring points but in exploring the world in which the game is set and learning about its denziens . . this program goes to prove that the mental pictures conjured up by a good textual adventure can be far more vivid than the graphics available on home computers." *– Which Micro?, Feb 84*

"**Lords of Time.** This program, writen by newcomer Sue Gazzard, joins my favourite series and is an extremely good addition to Level 9's consistently good catalogue . . As we have come to expect from Level 9, the program is executed with wonderful style – none of those boring "You can't do that" messages! Highly recommended.", *– PCW, 1st Feb 84*

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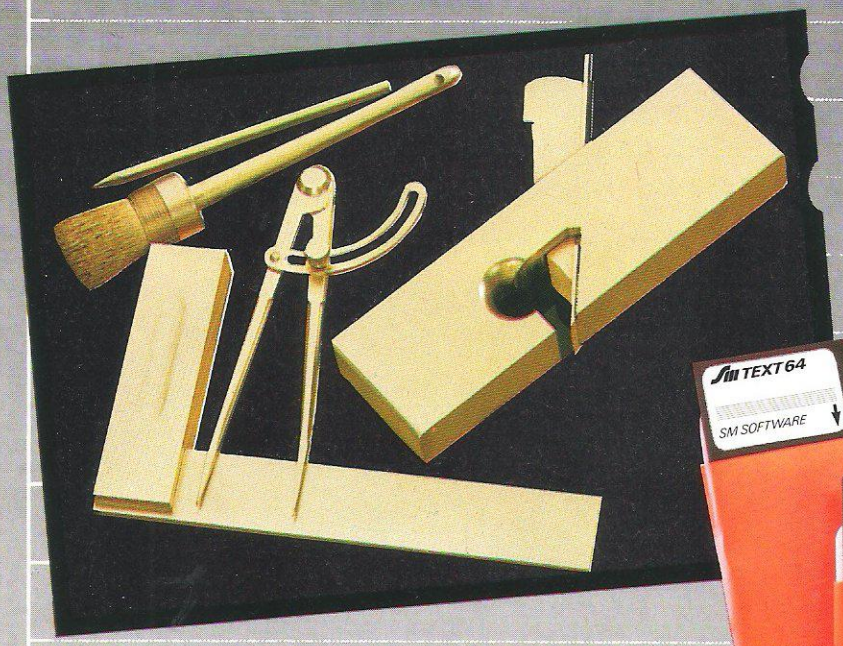

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SX-64 REVEALED

This month we got our hands on the SX-64, the portable version of the 64, and put it through its paces to discover its good – and bad – points.

Commodore Computing Path

At last the SX-64, the portable version of the Commodore 64, has reached UK shores. It has, of course, been available in the US for some time – our thanks to those US readers who have had a chance to get used to the new machine and offered us their comments.

If you're expecting something that looks even vaguely like the full size 64, forget it. Apart from the Commodore logos here and there, at first glance there's nothing to indicate the two are even related. Those 64 enthusiasts who have developed an affection for the machine which even extends to the muddy brown colour might be offended by the dark grey colour of the SX-64.

It measures 14.5 inches square and is 5 inches deep and weighs approximately 10.5 kilograms. A carrying handle acts as a support when the computer is set up. The keyboard doubles up as a lid which covers the monitor screen and the disk drive slot. On our model we found the catches on the lid a little tricky and if you weren't careful, or on the other hand if you were a little careless, you might lose the lid. It is very simple to set up – there's just one connection between the keyboard and the main body of the

computer through a 25-pin lead and apart from that all you have to do is to plug it in and switch on.

So far, so good. But now you start to encounter problems. None of the problems is, it is true, all that serious and many of them are inevitable – caused by restrictions imposed by the computer's portability. It's unfortunate that, since the 64 has already been fully reviewed, reviewers can only look at what's new about the portable. This means that many of the good points which are common to both machines get passed over while the bad points of the portable are highlighted.

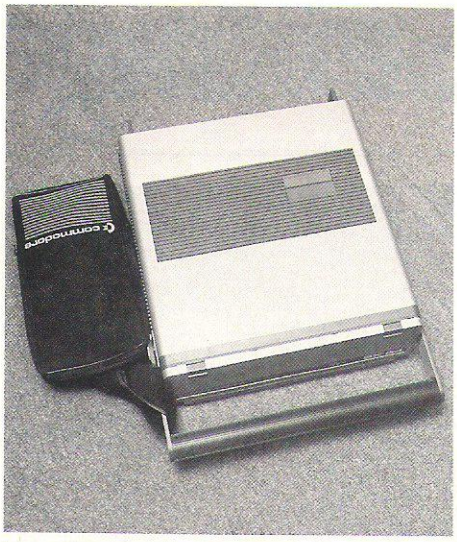
Suffice it to say that we at Commodore Computing International are great supporters of the Commodore 64 and believe there's no better computer for the price. All the advantages (and disadvantages) of the electronics of the big brother are present in the portable.

Our office desks are not noticeable for their remarkable shine but the SX-64 keyboard displayed an irritating tendency to slide around. We also found the keyboard a little less easy to use than big brother's. It's a smaller keyboard, very compact and the 67 keys appear to be slightly closer together and less steeply raked.

The 5 inch screen, although a full colour monitor, must be regarded as purely functional. It would be unwise to buy an SX-64 with the idea of using the built in monitor all the time. It's far too small for any prolonged serious use but is good enough as a temporary stop-gap.

The screen shows the standard 40 column display but it can be used as a window to handle 240 columns. The colour capabilities of the SX-64 are exactly the same as the standard 64. Colour, contrast, brightness and vertical hold are controlled by buttons located on the right of the front panel. The volume control is also found here.

The disk drive is basically a built in 1541 – a 17K, 5.25 inch floppy disk drive. What we fail to understand about the disk drive is why it interfaces in the way it does with the computer inside that nice grey exterior. Apparently the disk drive interfaces with the computer in exactly the same way that the 1541 interfaces with the big brother 64. It seems to us that an opportunity was lost here to speed up the disk drive. As everyone who owns a 1541 knows it is notoriously slow. Above the disk drive is a large slot marked storage. It's useful for storing the leads and may, perhaps, be useful for storing disks.



The SX-64, all packed up and ready to go!

At the back of the SX-64 is the usual array of two DIN plugs, an edge connector for a printer, two A-D interfaces and, of course, the on/off switch. A ROM cartridge interface can be found on top of the machine.

Where, you may ask, is the cassette interface? The answer has surprised most people – there isn't one. But the SX-64 is, after all, a business machine. The vast majority of business software is on disk. Can any business software that's on tape only and not on disk really be serious? And businessmen aren't expected to play games on their #900 computer. Unfortunately you do get the impression from the literature that the portable is a great idea because you can take it home with you the end of the day and the rest of the family can enjoy it.

While reviewing the SX-64 we began to question the whole idea of portable computers. The truly portable computers are a terrific idea. Tapping away at a keyboard on your lap in a crowded train compartment not only creates a great deal of interest (in the UK at least) it really does enable you to do work in circumstances which would usually be too inhibiting.

But there are a number of 'portable' computers which would more accurately be called transportable. They won't work without a mains supply and therefore cannot be used while you're on the move. The photographs that accompany the literature show scenes that give the impression that SX-64 is truly portable.There's a suitably macho man standing in the middle of a building site carrying his SX-64 – and not an electrical supply in sight.

Who will use the SX-64 and computers like it? And why would they buy the SX-64 rather than the big brother 64? There are obviously the people around who want the machine since Commodore say they are selling well – they had 1,500 pre-Christmas orders.

We could not come up with one absolutely, undeniable, concrete reason why the portable was a better bet for any of us than the full size version. We had this nagging feeling at the backs of our minds that Commodore had not put a tremendous amount of research and development into producing a really good portable computer. It's rather as if they said to themselves: 'Hey – what if we stick the 1541 disk drive in a box with the computer parts of the 64, then add a little monitor, copy Osborne and put a keyboard in the lid? That'll give us a nice portable without all the bother of all that research and development.'

SX-64 Modifications

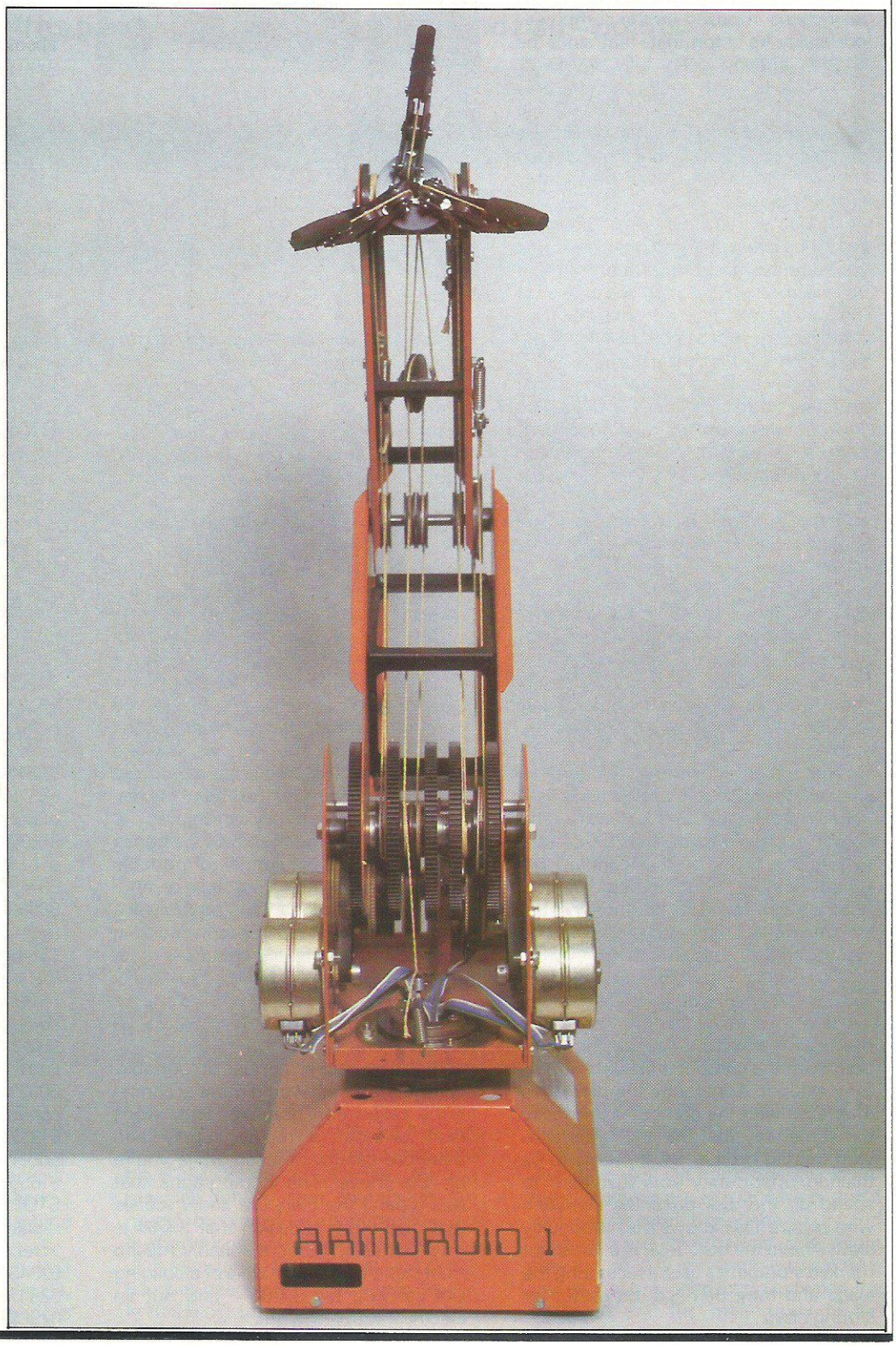
We have made a comparison between the ROM's of the 64 and the ROM's of the SX-64. Following is a list of the differences between the two systems.
There are no alterations to the Basic ROM.
We have found that there are quite a few modifications to the kernal ROM however.

ADDRESS ALTERATION.

58489-58515 The Power up message has been altered to give sx-64 instead of commodore and v2.0 replaces v2.
58540 Also in power up message.
58579-58588 Added routine replacing blank memory.
58677 New Cursor colour (Blue instead of Lt. Blue).
58748-58869 Set screen pointers routine.
58863 Input from keyboard routine (branch).
58868-58869 New address for SHIFT/RUN-STOP.
58914-58915 New address for retreat cursor routine.
59911-59922 Modification to clear screen line routine.
60633-60634 New default border and screen colours.
61332-61334 Jump from routine to added routine at 58579.
61656-61670 String for SHIFT/RUN-STOP: 'LOAD ":*", 8 <ret>RUN<ret>' replaces the now useless command of '<ret>PRESS PLAY ON'.
62343 Modified branch in open file.
62647 Low byte of a jar in load routine.
62969 Branch in save routine.

Getting to grips

Once every couple of months the media get hit by a massive dose of robot mania. Suddenly newspapers and TV programmes are predicting the end of manual labour for humans. The evidence for this rash prediction is usually the launch of an inordinately expensive bundle of plastic and wires that trundles around so clumsily that you'd never trust it with something as valuable as a Martini. With recent launches of robots that can be controlled by a home computer such as the 64 we thought it was time we looked at the sort of robotics that's accessible to the general public.



with Robotics

The public has been made aware of the current capabilities of robotics through news of manufacturers such as British Leyland using robots in the production line, and through robots used for promotional purposes at exhibitions. Even the Prime Minister recently came face to face with a robot at a conference hall where she was greeted by a bespectacled robot complete with bowler hat saying "Good morning Prime Minister, how nice to meet you."

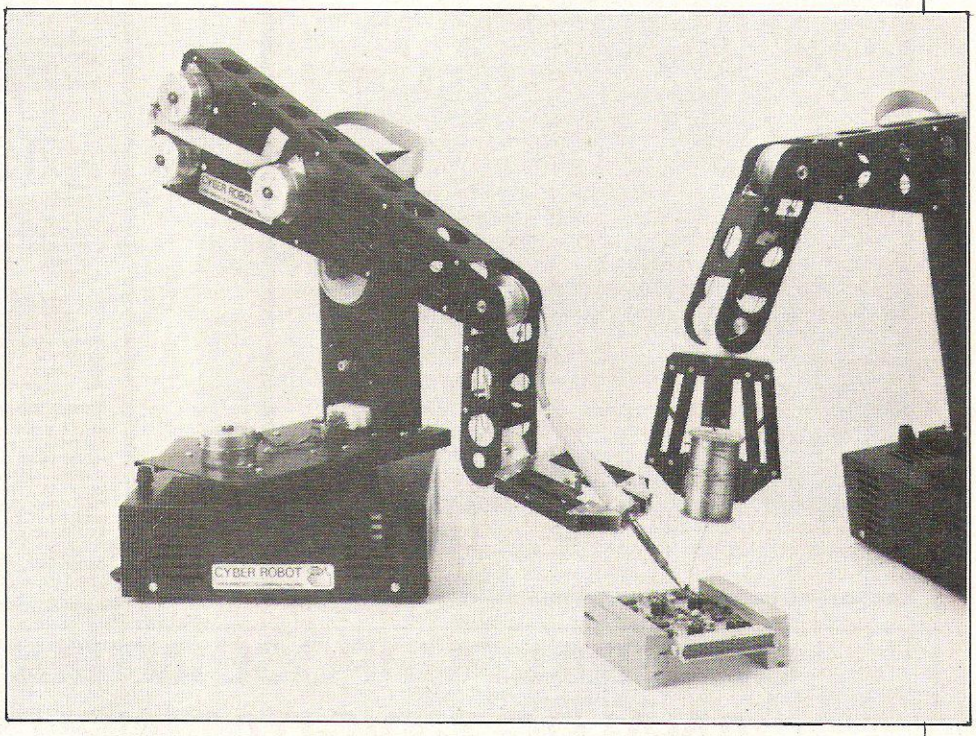
People have also been given a tantalising futuristic look at robots through such lovable robotic characters as Star Wars hero C3PO.

Techno-fear is an expression often heard when new technology is discussed, but it wasn't the reason behind the refusal of American casino chiefs to install a robot croupier. They were worried that it could learn to cheat customers!

Many people dream of having their own personal robot slave to perform all those tedious household chores and to wait hand and foot (should that be wheel?) on them. Unfortunately it will be many years before these dreams can be realized. However, less sophisticated forms of robotics are accessible to the public. Robot arms, for instance, are an interesting introduction to the world of robotics and a number of companies are coming out with robot arms that can be driven by popular micros like the 64, at a price within reach of the general public.

The brightly coloured robot arm pictured here comes from Colne Robotics and is available in kit form for around £400. Called Armdroid, it rather resembles a toy crane. It won't do the cleaning or make the tea, but it can be programmed by your computer to do simple tasks like picking up an object and moving it from A to B.

Colne Robotics' Armdroid is a relatively simple but ingenious robot arm. Perhaps it's a little beyond the pocket of the average micro owner but at around £400 for the kit it's ideal for educational purposes. Nearly everything is showing – all the cogs and gears are visible so it's easy to see how it works mechanically – and, in spite of the brightly coloured sheet metal from which the casing is made, it does look, in some respects, a little like a string driven thing. But what looks like string is, in fact, special carbon fibre, enormously strong and almost impossible to stretch.



Cyber Robotics' robot arm, the Cyber 310, is pictured above demonstrating the accuracy to which a robot arm can be positioned. Operating along the same principles as Colne's Armdroid, Cyber Robotics' arm emulates a full-size industrial robot. It's operating system is an extension of FORTH which permits speed control. Slow movements allow close analysis or critical control.

Like most examples of robot arms this one uses stepper motors which receive the instructions from the computer. The Armdroid has five such motors and on the printed circuit board that makes up the interface, hidden at the base of the arm, there are also five chips. Each chip send instructions to one of the motors. There is also some overall control of the arm.

Stepper motors, of course, move step by step. The size of each step is predetermined and the number of steps taken depends on the amount of current applied and the period for which it is applied.

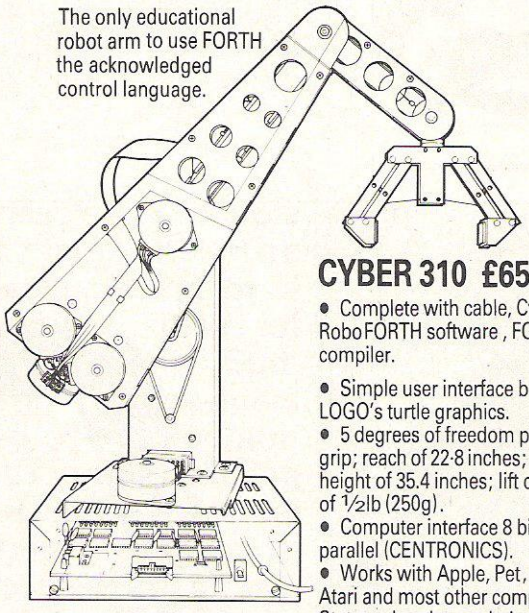
Another robot arm on the market is the Cyber 310 from Cyber Robotics. At around £650 the Cyber arm is more expensive than Armdroid and uses an extension of FORTH called ROBOFORTH. This permits individual complex motions to be learned, combined and played back allowing the user to understand what is happening without the assistance of a computer expert.

Cyber 310 has five degrees of movement, a programmable gripper action and the ability to rotate the shoulder 300 degrees in the vertical plane to operate on the opposite side with the arm upside down, giving the robot greater flexibility.

One of the major setbacks with most robots is that they cannot 'see'. Move an object a few inches away and it won't be able to find it. Dr Peter Davey has developed a robot that can see, using a laser and tiny television camera in the 'business' end of the robot. The laser provides a brilliant flat illumination so the robot is not confused by varying

The FORTH ROBOT

The only educational robot arm to use FORTH the acknowledged control language.



CYBER 310 £650 plus VAT

- Complete with cable, Cyber's RoboFORTH software , FORTH compiler.
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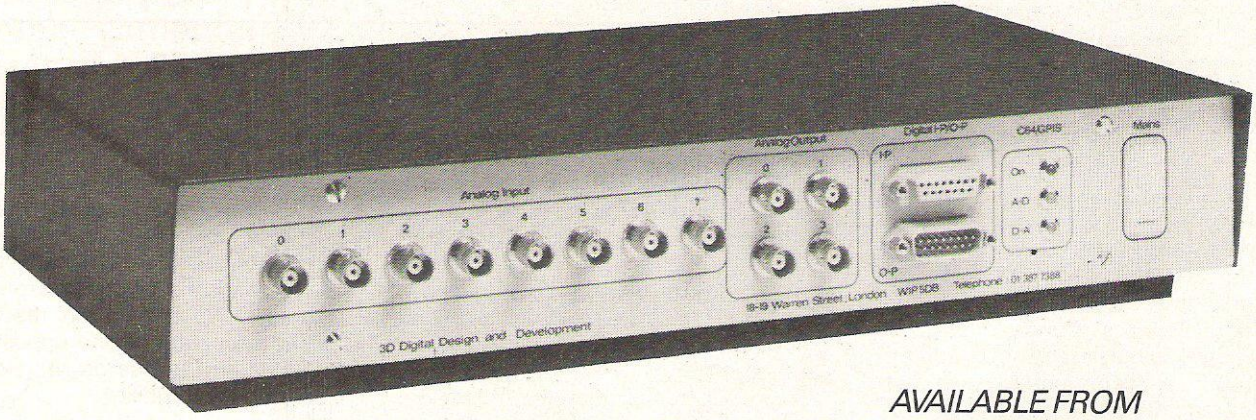

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shades. This is particularly useful in industry where the robot needs to remain on target. Davey is now programming the robot to inspect and touch up shoddy work.

There are robots on the market which do have the appearance people have come to expect from a robot. Not humanoid by any means, but with friendly looking 'faces'. They perform some basic functions, but can really only be described as a very expensive toy out of the average man's financial reach.

Prism have recently launched two personal robots, Topo and FRED (Friendly Robotic Educational Device). Topo is three foot tall and will cost you around £1,500. He (she? it?) is controlled via a personal computer or joystick. A wireless infra-red communications link relays information from the computer to Topo. Topo is capable of speech and movement, but is by no means stable enough on its feet (in this case two independentally driven wheels) to carry your drinks to you without spilling a drop.

FRED looks more like Dr Who's trusty companion K9 and, at just over one foot high, performs on a table top or on the floor.

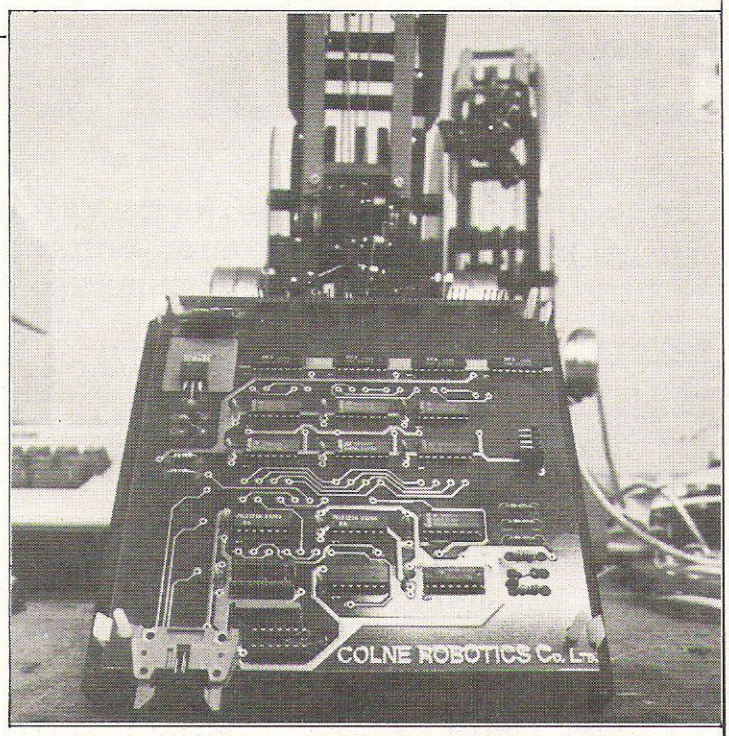
Retailing at around £200, FRED comes complete with a portable infra-red remote control although it may also be operated via a personal computer.

A drawing pen attachment allows the user to create patterns on a computer screen which can then be translated onto paper by FRED. Like big brother Topo, FRED can speak. A 45 word vocabulary is optionally expandable.

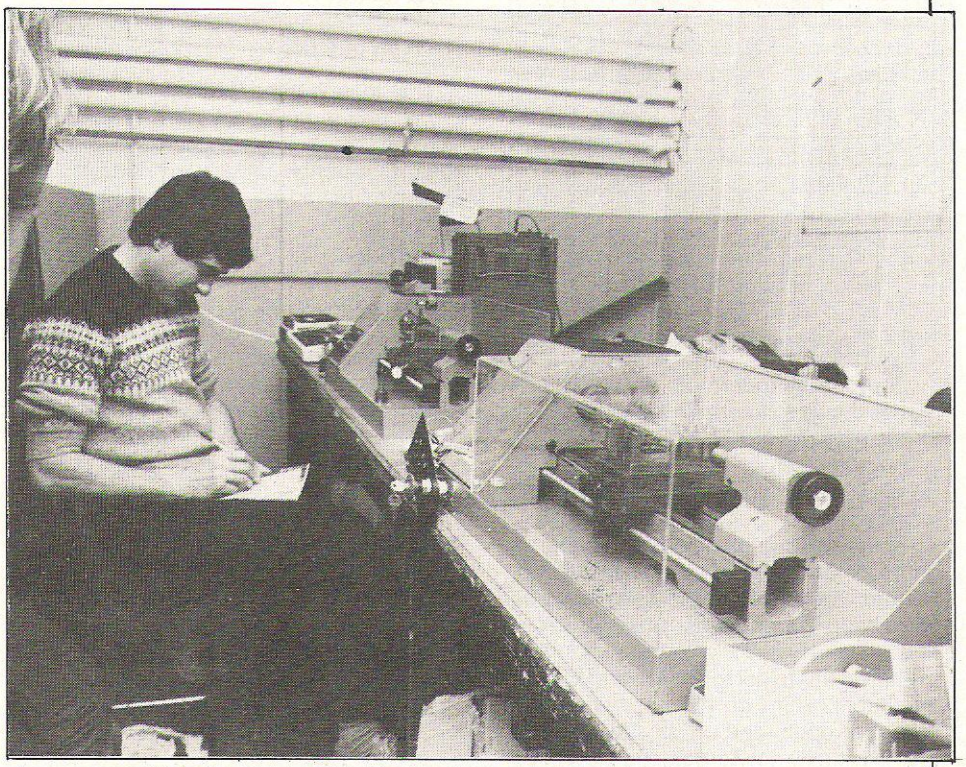
Although primarily a toy at present, Prism's plans for the future include applications such as intruder detection, smoke detection, hoovering/lawnmowing, and fetching and carrying for invalids.

Hoover have produced a remote control vacuum cleaner which is operated by a joystick similar to the ones used in playing computer games, and hope to be able to include a programming facility which will enable the machine to find its own way round the room. However, these are not likely to appear on the market just yet as even the remote control model would cost up to four times as much as the latest push-around models.

So keep dreaming about your own personal robot slave, but for now why not consider an introduction to robotics through the sort of robotics currently accessible to the public such as a robot arm.



The printed circuit board of Colne Robotics' Armdroid, pictured right, contains a user-port compatible interface and the logic for controlling the direction of movement and the selection of which stepper motor is to be activated. It also contains the drivers to power the motors once it has been decided which way they are to move.

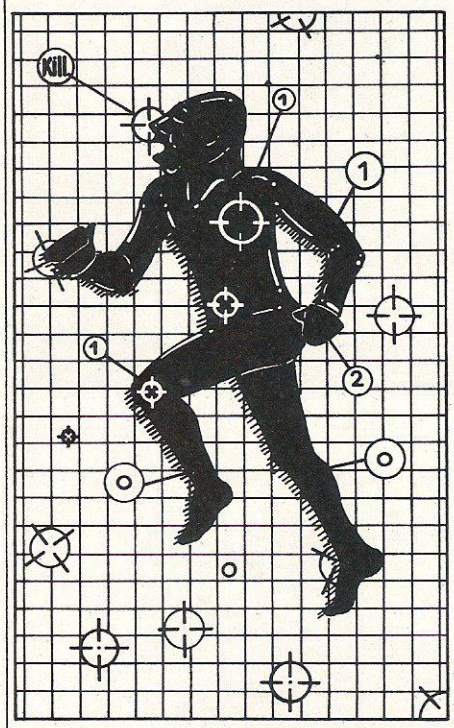


Colne Robotics' latest venture is a lathe. Once again it's designed especially for educational purposes. It can teach newcomers to the lathe how any lathe works but especially how a computerised lathe works. The piece to be turned can first of all be designed on the monitor and can be viewed as a three dimensional object. It is therefore possible to see exactly what the finished piece will look like before work starts.

The lathe is designed to interface to any parallel port 8-bit micro. The software that Colne Robotics supply provides a comprehensive range of G-codes and the facility to accept and retain complex cutting sequences. The lathe is the first in a planned range of educational machine tools.

Enter Zorgon's Kingdom

An assortment of new games for the VIC-20 and the CBM-64 this month, from the usual 'zap! pow!' variety to an adventure game rumoured to be so hard that the manufacturers supply a free clue!



Zorgon's Kingdom

Zorgon's Kingdom is one of those games that is so frustrating the player has to keep on playing and playing until the game is mastered. This new game from Romik is played on the VIC with 8K or 16K expansion.

Zorgon's Kingdom is not an adventure game although the title suggests that it is. Neither can it accurately be described as an arcade game. It is really a cross between the two. It is an adventure in that the player has to get to Zorgon and kill him by shooting him on the nose when his mouth is open, and an arcade game in that to actually get Zorgon, the player has to avoid holes, rolling bombs, rockets and aliens.

The game itself is split into five sections and, naturally, to progress from one section to the other each screen has to be completed successfully.

The graphics are quite good although the movement of the sprite is sometimes a little slow.

Title: Zorgon's Kingdom
Programmer: Chris Stamp
Company: Romik Software, 272 Argyll Avenue, Slough, Berkshire
Type of game: Arcade/Adventure
Graphics: Quite good. Movement is a bit slow
Hardware required: VIC with 8K or 16K, television or monitor, cassette player, joystick (optional)
Description: Successfully complete the five sections of this game and kill Zorgon
Price: £6.99 including VAT, post and packaging
CCI rating: ***

Millie-bug

The idea behind Millie-bug, a new game for the Commodore 64 from Dk'tronics, is to destroy as many of the bugs as possible. It is very similar to Exterminator and imitation is the sincerest form of flattery.

Millie-bug has nine skill levels although the first five are not worth bothering with because the action is slow and rather boring.

The graphics are fairly good, especially on the introductory screen and the sound effects are quite realistic. These cannot and do not make up for the lack of excitement and speed in other areas of the game. To get the maximum enjoyment from the game the user should go straight to level nine and stay there.

The program is recorded on both sides of the cassette.

Title: Milie-bug
Company: Dk'tronics, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AX, Telephone 0799 26350/222359
Type of game: Arcade
Graphics: Average
Hardware required: 64, cassette recorder, television and a joystick
Description: Kill the catterpillars
Price: £5.95 plus 50p for post and packaging
CCI rating: ***

Snooker

Snooker is a machine code one or two player simulation game that runs on the 64. Control of the game is either by keyboard or by joystick and after the game has been loaded a check is run to see if a joystick is attached.

If there is not a joystick attached, it is assumed that the keyboard is the input medium with the cursor and the S key moving the cue and the cue ball. For firing use K.

It is possible to play a 15 or 10 ball game and the first break is made by positioning a '+' at a user defined position. This cross represents the line the cue ball will take to the target point. The actual strength of the shot is determined by the length of time the fire button is held down.

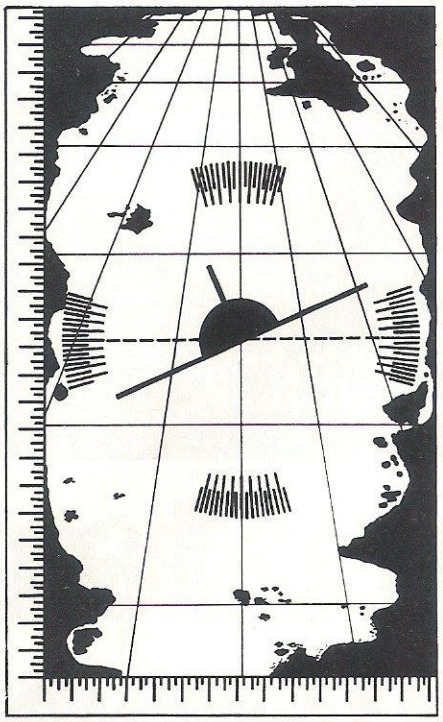
The best feature about this game is the ability to put spin on the cue ball. To do this all the player has to do is move the joystick or cursor in the direction of the spin, pressing the fire button at the same time. Release the fire button but continue to press the joystick.

Whilst putting spin on the cue ball is a very nice feature, the movement and sound of the balls leaves something to be desired. The balls often move quite slowly and when they actually touch, the sound is definitely not ivory or hard plastic. It is more like a fire cracker that has gone wild.

That is the only bad point of a game which includes all the features of a normal game of snooker and has some good hi-resolution graphics.

Title: Snooker
Company: Visions (Software Factory) Limited, 1 Felgate Mews, Studland Street, London W6 9JT
Type of game: Simulation
Graphics: Good
Hardware required: 64, cassette recorder, television and a joystick (optional)
Description: Snooker
Price: £8.95 including VAT and post and packaging
CCI rating ***

-then pot the black



Flight Simulator

The object of the Flight Simulator from Anger Productions is to fly an aircraft from Heathrow to any of eight destinations within the UK. It is a pity that more was not made of the capabilities of the 64.

In all, there are three separate screens. All of the destinations are displayed on a map of the UK which can be displayed at any time and there is a screen showing the current grid reference of the aircraft. The final screen is that of the actual cockpit and on this screen the player is presented with the compass controls and all the flight indicators.

There are three phases to this game, the first being the take-off phase where the player decides on the destination and must get the speed up to at least 130 knots. The second phase is when the aircraft is actually airborne and the user is given cockpit prompts and warnings – the worst thing that can happen is allowing the speed to fall below 60 knots which results in a fatal nose dive. When airborne, you must fly to the exact map reference before making any attempt to land.

The game makes quite an interesting diversion without being too taxing on the brain or reflexes.

Title: Flight Simulator
Company: Anger Productions, 14 The Oval, Broxbourne EN10 6DQ telephone 0992 461156
Type of game: Simulator
Graphics: Average
Hardware required: 64, cassette recorder or disk drive, television, joystick (optional)
Description: Fly the airplane!
Price: £9.95 cassette, £11.95 disk
CCI rating: * * *

Ship of the Line

Ship of the Line is a new strategy game for the 64 which takes the player back to the days of the 17th century and many naval battles in the Mediterranean.

The whole point of the game is to gain promotion from midshipman to First Sea Lord. This is done by winning the favour of your superiors and winning as many naval battles as possible.

There are, however, other factors which must be taken into account. The player must ensure that there is adequate supplies of food, water, ammunition and enough crew to man the ship. If not, the player may be forced to surrender in the middle of a battle or be murdered by his own crew.

As the game progresses, the crew of the ship gets bigger as does the supply of ammunition and enemy forces but a major disappointment in the game is the poor use of the 64's graphic capabilities. The basic screen is that of an horizon with a few clouds and enemy ships. The actual battles are graphically unexciting leaving a lot of room for improvement.

Title: Ship of the Line
Company: Richard Shepherd Software, Elm house, 23/25 Elmshott Lane, Cippenham, Slough, Berkshire, Telephone 06286 63531
Type of game: Strategy
Graphics: Poor
Text: Average
Hardware required: 64, television, cassette recorder
Description: Wage war on the high seas and gain promotion
Price: £6.50 including VAT and post and packaging
CCI rating: ***

Snowball

Anybody coming across the game called Snowball for the first time might assume that the game was all about winter sports. Snowball is in fact a textual adventure game that takes place in space. It uses a massive 32K of the 64's memory and the aim of the game is to ensure that the starship Snowball docks safely with the target planet of Eden

The big question is how do you avoid the deadly nightingales as soon as you manage to get out of the coffin?

Level 9 Computing claim that the game has well over 7000 locations and 60 objects. The budding astronaut has to solve a large number of puzzles while finding his way to the main control room and saving the starship.

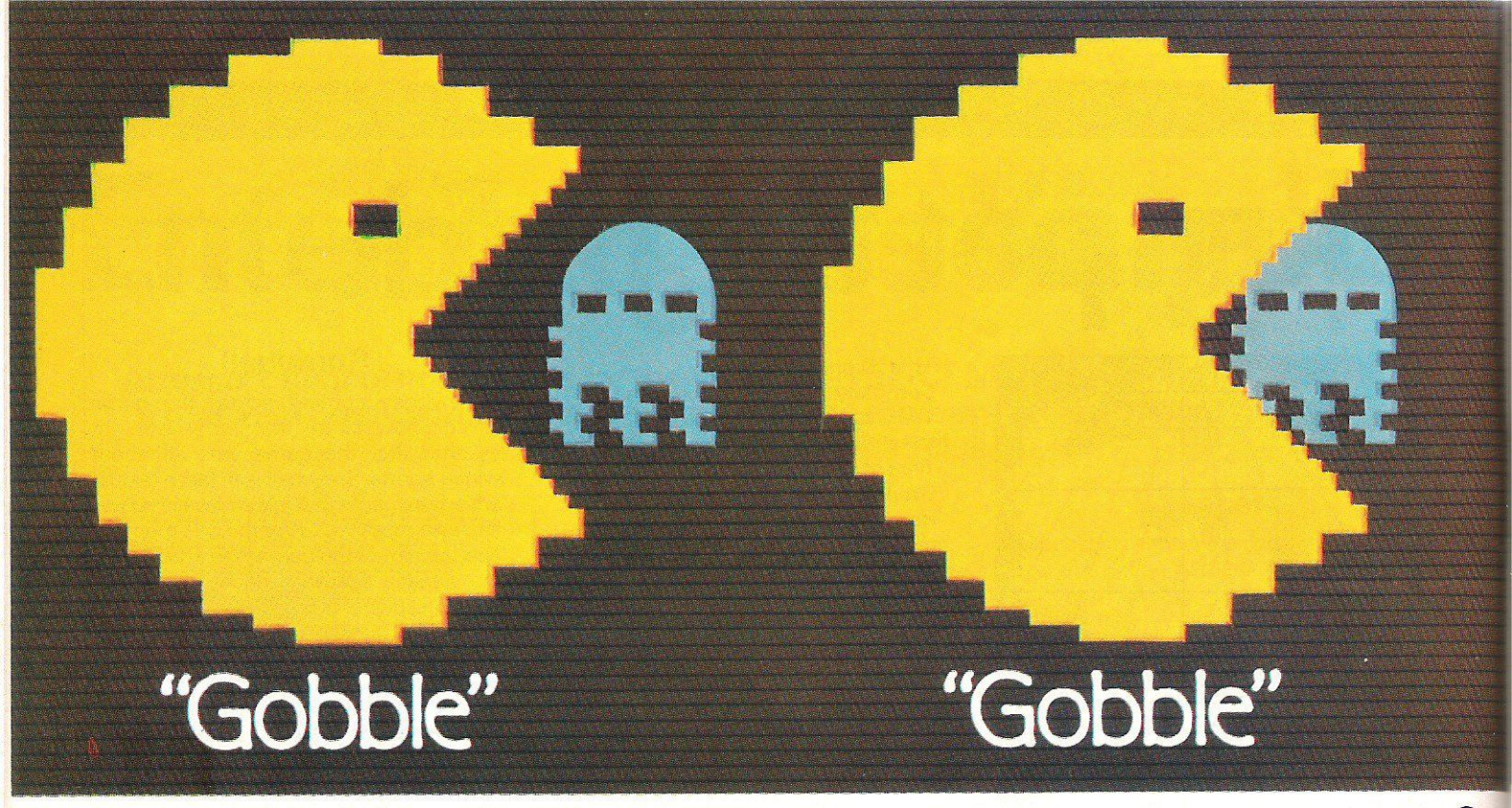
The dictionary that comes with the program is limited to 200 words and this is only sufficient enough to allow commands of three or four words to be input.

Movement is dictated either by compass directions or by left, right, up, down, forwards and backwards.

Unlike many other adventure games, the player does not score any points for collecting objects and storing them away. Points are gained by progress. For example the user will get points for getting out of the freezer coffin and assembling the space suit. It is also possible to lose points if the player is killed or caught by one of the dreaded nightingales.

This is definitely one of those adventure games that will take weeks to solve and possibly months. It is so difficult that Level 9 Computing are supplying the consumer with a free clue.

Title: Snowball
Company: Level 9 Computing, 229 Hughenden Road, High Wycombe, Bucks HP13 5PG, telephone 0494 26871
Type of game: Textual adventure
Text: Good
Hardware required: 64, cassette recorder, television
Description: Find your way to the main control room and save the starship
Price: £9.90 including VAT and post and packaging
CCI rating: ***



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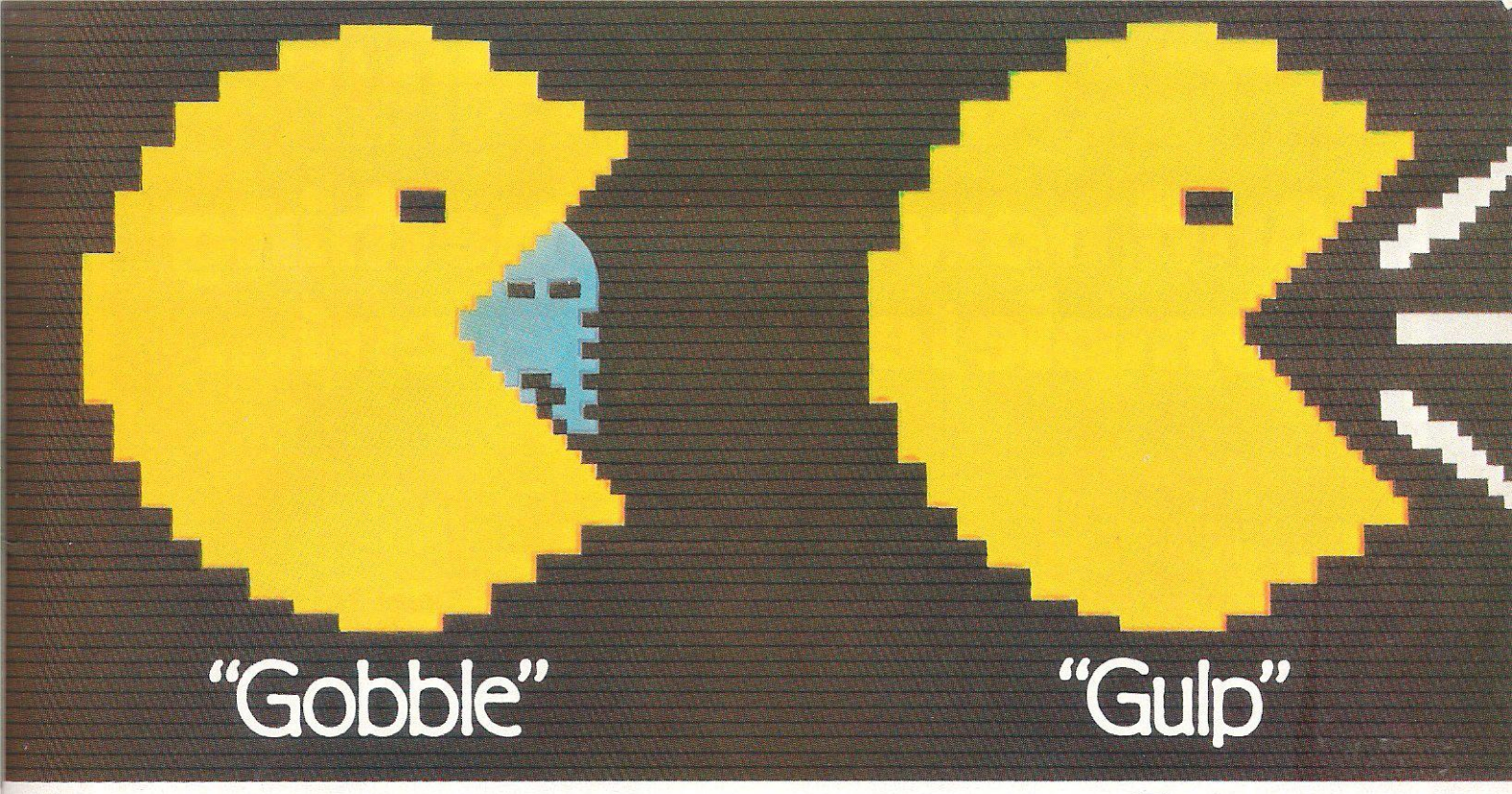

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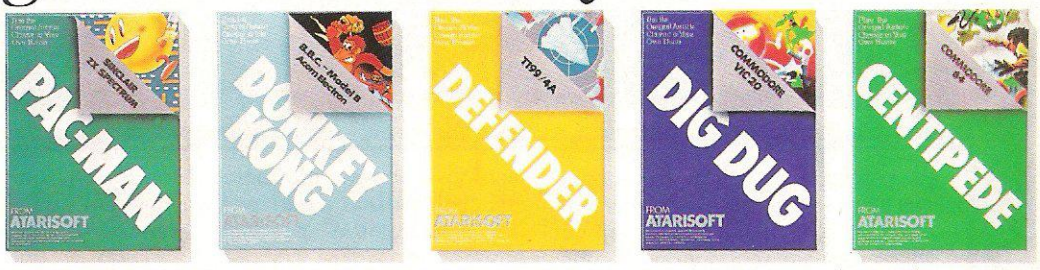

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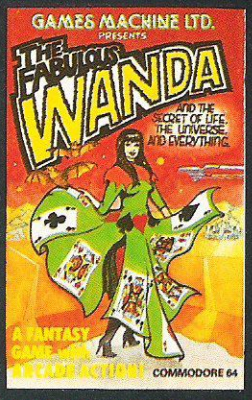

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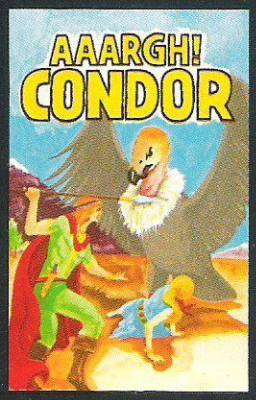

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George at once becomes the hero but he has many hazards to overcome including deadly arrows from the local warrior, deadly creatures and eggs carefully aimed from the air. Can George make it to the top of the mountain to take the spear and kill the bird? *Will George finish the game before he drops his pipe and burns the house down?!*

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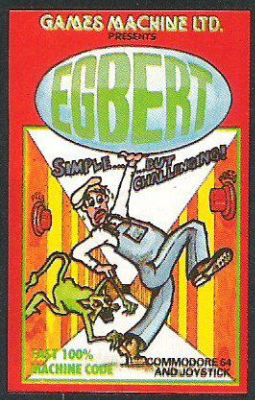

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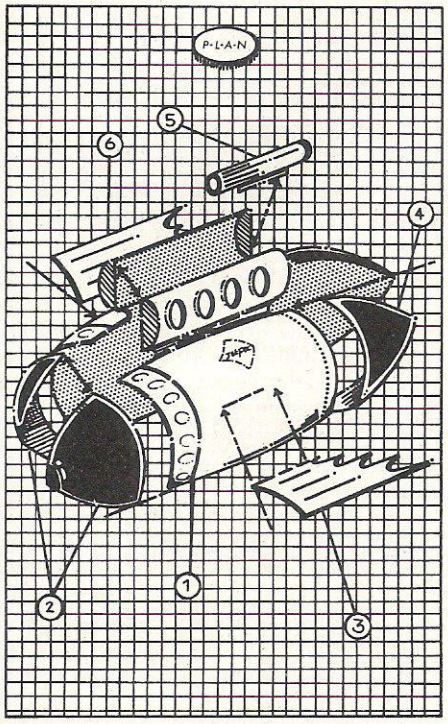

Jetpac

Imagine being transported to the outer reaches of the galaxy, being the richest person in the universe and a chief test pilot for the Acme Interstellar Transport Company. If you can imagine you could probably play Jetpac well.

This is a new game for the VIC with 8K expansion. The aim is to asssemble a number of rockets on several planets, collect priceless treasures and destroy as many aliens as possible.

The ship is initially divided up into three sections, each section being located at different parts of the planet, which the player reaches using the latest Hydrovac Jetpac. Once the rocket has been assembled and refuelled all the player has to do is enter the spaceship and then . . . liftoff! The player is transported to another planet where the task is exactly the same.

Control of the realistic looking astronaut is either via the keyboard or joystick, enabling the player to moonwalk and hover in mid-space. The graphics and sound effects are quite good considering the game is for the VIC and not the 64.

This is a one or two player game, with the number of lives left, high score and individual score being recorded at the top of the screen.

Title: Jetpak
Company: Ultimate Play The Game
Address: Ashby Computers and Graphics Ltd., The Green, Ashby-De-La Zouch, Leicestershire LE6 5JO telephone 0530 411485
Type of game: Arcade
Graphics: Fair
Hardware required: 8K VIC, television, cassette player, joystick (optional)
Description: Travel the stars, assemble spaceships and gather the treasure
Price: £5.50
CCI rating: * * *

Pedes and Mutants

The instructions to Pedes and Mutants are a little bit difficult to read but well worth preservering with. It is a new game for the unexpanded VIC from Romik and after reading the description provided on the cassette cover the game sounds like an ordinary 'shoot-the-aliens' creation.

This is exactly what it is but with some noticeable differences – and what differences they are! The game is split into two parts although there is no great difference between the two. The whole object of the game is to get as many points as possible although the action is so fast the player cannot tell exactly what is being hit or, for the first few games, what scores how much.

In the first part of the game the laser cannon is not stuck to the base of the screen but is positioned close to the top with the Pedes moving quickly towards it. To kill the Pede (which is worth 1000 points) it has to be shot about 10 times. There is so much happening and the action is so fast, the player has to keep moving and firing. Pedes are not the only aliens that have to be destroyed because fleas and ants make an appearance as well.

It is not until all the six Pedes have been destroyed that the player can progress onto the second screen. In this section of the game, the laser moves like an upside down pendulum and all the mutant invaders must be destroyed. Should one escape unharmed, the player will be back to square one on screen one.

Bonus points are awarded for destroying landing bases and motherships and an extra life is awarded at 10,000 points. The beginner to this type of game will be thankful for the choice of skill levels and for the fact that the action can be held.

The flashing multi-colour screen is a little aggravating to the eyes but on the whole the graphics are good with excellent explosive effects and some interesting use of sound effects.

Title: Pedes and Mutants
Programmer: Pete Bradley
Company: Romik Software, 272 Argyll Avenue, Slough, Berkshire
Type of game: Arcade
Graphics: Good
Hardware required: Unexpanded VIC, television or monitor, cassette player and a joystick (optional)
Description: Get as many points as possible by destroying the aliens
Price: £6.99 including VAT
CCI rating: ***

Jackpot

Mr Chip, who designed the excellent game Westminster (see volume 2 number 7) have now brought out two versions of the fruit machine simulation game Jackpot. One is for the VIC and the other is for the 64 and both are written in machine code.

There are some minor differences between the two versions. With the VIC version the player gambles with pennies rather than pounds and the layout of the screen is slightly different. Obviously, the 64 has much greater graphic facilities and these are used to their full extent. The excellent graphics are not hi-res but user defined character graphics!

On the 64 it is possible to reach a maximum total of 250. To reach the maximum total on each game there are several features. Whenever the player wins there is the option to gamble, the maximum and minimum amount available being highlighted by flashing lights.

On the VIC version there are no numbers by the side of the fruit, the number of nudges being determined by the response of the player to the nudge panel at the bottom of the screen. On the 64 version, the number of nudges relates directly to the sum of the numbers to the right of the fruit. If this total is equal to seven the shuffle win comes into play. With this feature the reels spin a random win of 3 or 5.

When the number of nudges has been assessed, another handy feature is autonudge which is accessed by the function keys. Autonudge is only available on the 64 and means that the micro will automatically nudge the reels to the best available win with the available nudges.

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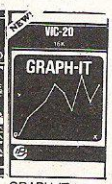

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Dictator

In Dictator, the player is placed in charge of a small banana republic called Ritimban. Many dictatorial regimes are based upon large support from the armed forces and a questionable relationship with the populace. Dictator is no exception.

The aim of the game is to stay in power for as long as possible by retaining the favour of the army, secret police and landowners and siphoning off money from the State into a Swiss bank account.

Dictators will often get assassinated and this is only one of the difficulties that the player has to avoid. There is the threat of invasion from neighbouring countries and revolution by the peasants.

The popularity of the dictator is indicated by several circles that appear on the police report. This report is influenced by the actions of the dictator. Support from the peasants will increase but support from the landlords will decrease when the peasants are given free education.

The game takes on an international dimension with the entry of the Americans and the Russians – their financial support is quite important when the bottom falls out of the banana trade!

This game is based completely on text and has practically no graphics at all which is surprising because the game is for the 64. Surely some improvements can be made in that area? Despite this, Dictator is an interesting and enjoyable game.

Title: Dictator
Company: Dk'tronics, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AX. Telephone 0799 26350/22359
Type of game: Strategy
Graphics: Poor
Text: Average
Hardware required: 64, television, cassette recorder
Description: Stay in power for as long as possible
Price: £5.95 plus 50p for post and packaging
CCI rating: ***

Megawarz

Travelling from Pluto to Earth is your mission in this game from Paramount Software. Between each planet, a group of aliens is waiting to ambush you and these have to be destroyed before you are allowed to continue to the next planet.

The aliens, instead of firing at you, simply have to touch you to ensure your annihilation and what's more are virtually indestructable. The only way you can progress on your mission is to wait for an alien to recharge its force field. Luckily you can see when this is happening as the alien, which is constantly changing colour, changes briefly white. It is in this brief period that you have the chance to destroy it.

This is the scenario in this very professionally put-together shoot-em-up game. Your ship, joystick or keyboard controlled, is thus involved in a delicate cat and mouse game where you must keep close to the aliens to blast them, but far enough away for sudden changes of direction not to have you running into them.

Many other ships seem to have failed to get through as occasionally the body of an astronaut floats through the screen. These are well worth picking up for bonus points and to recharge your shield which allows an alien to pass through you without damage but at great expense to your energy reserves.

After each wave of aliens has been cleared, a bonus screen with several astronauts drifting about gives you a chance to refuel. On this screen, however, if you miss picking any astronauts up, they mutate in to particularly nasty aliens. Having survived this screen there is a delightful graphical trip to the next planet, which gives you time to catch your breath ready for the next onslaught. Of its kind a great game, and good value for money.

Name: Megawarz
Programmer: Jason Benham
Company: Paramount Software, 67 Bishopton Lane, Stockton, Cleveland.
Type: Arcade
Graphics: Good
Price: £7.50
CCI Rating: ****

Golf

Archdale Golf Club is an 18 hole par 72 course. You are asked to provide your handicap, and to admit to the worst feature of your game before beginning your round. Each hole is drawn randomly, and the distance to the hole and its par are given. At each stroke of the ball you have 13 clubs to choose from, each club will hit the ball a different distance.

All the expected hazards are presented, heavy rough, trees, bushes and the occasional stream are all to be avoided. When you are on the green, a seperate display shows your ball in relation to the flag.

After getting around the 18 holes, your score has to be entered, and an appropriate comment on your performance is given.

This game was a disappointment, the graphics were all standard Commodore keyboard characters, and the game looked as if it were on an unexpanded VIC rather than a 64. Your control over the ball's direction is minimal, you merely have the option to fade or draw (whatever that means). There is no animation of the main screen and the ball simply disappears when struck by an invisible golfer, and reappears somewhere else. The program seems to have been written in very basic Basic as the delay between taking a shot, and the screen reporting back that you are 'on the fairway' or whatever is not inconsiderable. The most skilful stage is on the green where you have to judge how hard to hit the ball, but a white blob jerking along a featureless black line to a stationary flag doesn't exactly make for a great evenings entertainment.
Name: Golf
Programmer: Ian Green
Company: Anger productions, 14 The Oval, Broxbourne EN10 6DQ
Type: Arcade/Simulation
Graphics: Poor
Price: £ 7.50
CCI Rating: *

Ludo

A competent and accurate program true to the original game in every way. There is a nice touch about the dice as they are shaken in a 'hand' rather than just being dots flickering in a box as they mostly seem to be.

From one to four players can take part although there is no option to play against the computer. Obviously a great deal of thought has gone into this program, unfortunately putting a boring game onto a new computer does not stop it from being a boring game.

This was a review sample only so maybe it will appear as one of a compendium of games for the 64, in which case there may be some purpose to it. Anyone for computer tiddleywinks?
Name: Ludo
Programmer: CP White
Company: C P White (Computers & Software), 52 Northfield Avenue, West Ealing, London W13 9SY.
Graphics: Average
CCI Rating: *

A Living Legend

On January 13 Jack Tramiel resigned as president, chief executive and board member of Commodore. Tramiel has been the driving force behind Commodore for so long now that his resignation caused more than a few raised eyebrows. After all, to many in the business, Tramiel IS Commodore. Not any more. He will, we are told, continue as a consultant to the company. But nobody seems completely convinced that this is the end of the matter. Here we take a look at Tramiel, the man, and Tramiel the father of Commodore. How did he give birth to Commodore and what's it been like bringing up the child?

Jack Tramiel

All the cliches you can possibly think of – small beginnings... little acorns – apply to Jack Tramiel. He was the soldier at Fort Dix who repaired the US army's broken typewriters. After leaving the army he used his army experience and set up his own typewriter repair business in New York's Bronx.

The groundwork for Commodore was laid in the mid-1950's when Tramiel moved with his family to Toronto following the first of many successful business deals. It was around this time that Tramiel was developing the business skills which were to prove so useful later. The deal that took him to Toronto was a licence he negotiated with Czechoslovakia to assemble typewriters.

Although an entrepreneur himself Tramiel was a great believer in cutting out the middleman. It was this logic which led him to take over a typewriter manufacturing concern in Berlin. Why sell someone else's typewriters when you can sell your own?

Another of Tramiel's policies that led to his success is in keeping his ear to the ground. At this time he was quick to spot the growing trend for low-price mechanical adding machines flooding in from Japan and accordingly moved into the mechanical adding machine business.

In 1962, the company was of a sufficient size to go public, as Commodore Business Machines, Canada, with Tramiel as President of the company.

The longstanding team of Tramiel and Irving Gould came about after a scandal involving Tramiel's first Chairman, C Powell Morgan. Morgan was condemned by a Canadian Royal Commission Investigation in 1965 for 'his defiance of all accepted business principles' and for his acts of 'repacious and unprincipled manipulation.'

Tramiel was not indicted by the Commission, although the scandal did make bank financing hard to come by. It was at this time that a Canadian investor, Irving Gould, agreed to buy a large stake in the company and to become its Chairman.

Under pressure from Japanese imports, Tramiel visited Japan to get first-hand experience of his company's opposition. Here he saw the new electronic desk-top calculator and foresaw the end of high volume sales of mechanical adding machines.

He switched Commodore computer's strategy and when the first electronic pocket calculator appeared it was Commodore who took it to market.

Direct competition between suppliers taught Tramiel not to rely on outside suppliers for key components. Gould came to his rescue again personally guaranteeing a $3m loan, giving the company the buying power to purchase MOS Technology, then a struggling manufacturer of calculator and other semi-conductor chips. This was followed by the acquisition of Frontier, manufacturers of C-MOS chips, and MDSI, a liquid crystal display manufacturer.

The acquisition of MOS Technology gave Tramiel more than just experience in a key technology. It also gave him Chuck Peddle, the engineer who is reported to have told Tramiel to forget about hand held calculators and go for desk top computers. In line with one of Tramiel's favourite mottos 'Commodore is geared to giving consumers products they don't yet know they need,' he instructed Peddle to build a desk top computer. And so the PET was born.

The PET met with an enthusiastic response and as demand grew, Tramiel again decided to leave out the middle man and went direct to big retail chain stores. After the PET, of course, came the Vic-20 and the Commodore 64. And, as they say, the rest is history.

Tramiel's decision to resign 'for personal reasons' coincides with a record trading year for Commodore, with the company becoming the first microcomputer company to report sales of over $1bn in one year, more than doubling the previous year's sales. Speculation that Tramiel's decision to resign was not entirely of his own choosing has been denied by Commodore's Software Manager, Gail Wellington, who said: 'Tramiel is just tired. Last time I saw him he was having breakfast with Mr Smith (his successor) and I've never seen him looking so happy.'

And an interesting thought to end with. This is not the first time Tramiel has resigned. In 1982 he resigned his position but took it up again in a very short period of time...

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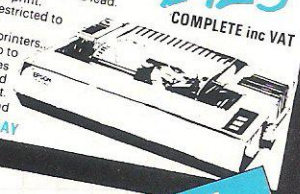

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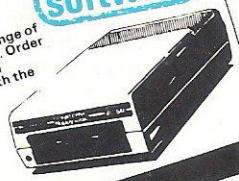

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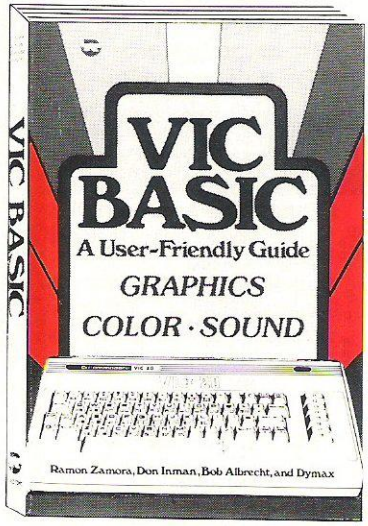

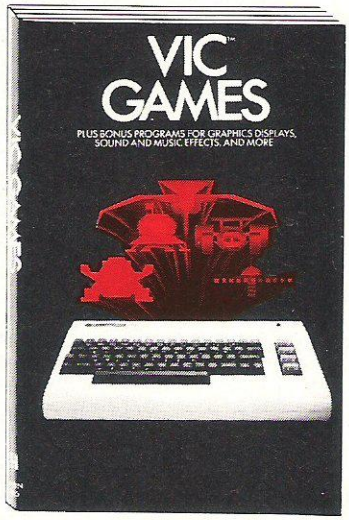

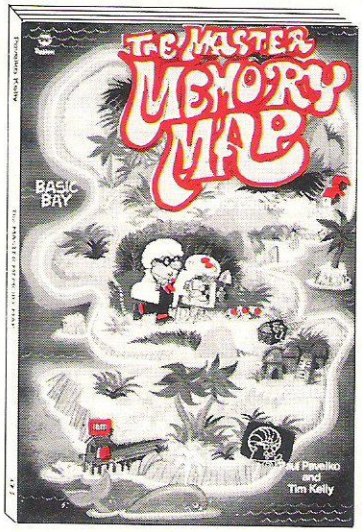

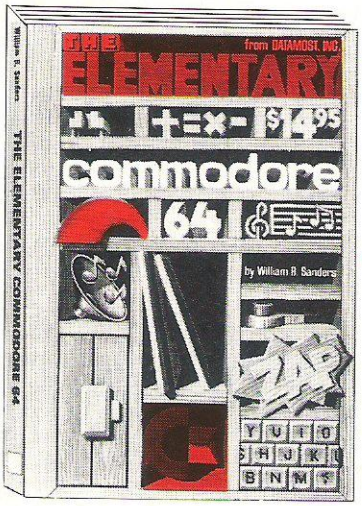

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CBM's easy wordpro

EASY SCRIPT is Commodore's very own word processor for the CBM-64. John Probert tests the product for us.

EASY SCRIPT comes well packaged in a stout box containing a couple of programmed disks – one is a thoughtfully provided backup copy – and a handsome blue book of about a hundred pages. This is the User Guide, and it is without doubt one of Commodore's best efforts; avoiding both the almost total inscrutability of the manual supplied with the (1540) disk drive, and the dreadfully overwritten instructions that come with its VIC Stock Control – this latter takes about twelve pages to tell you that the Stock Control program is a system for controlling stock!

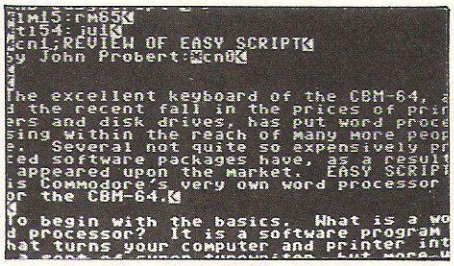
The disks would seem to be an expedient to get the processor on to the market early, for the intention, so I understand, was for it to be provided on a cartridge. This would be much more convenient, for then you could just plug in and go; but from a company that changes its mind about four times a week, I would not rely on its ever appearing. Certainly I have not been able to discover if it would be possible to trade in the disks against the cartridge, should it become available.

While loading the disk the screen shows the program title in a variety of colour combinations, and when loading is complete you are confronted with a disappointingly drab grey and white display.

You are first asked to choose the width of screen text. This would normally be (for the CBM-64) 40 columns, but up to 240 colums can be selected for exceptional text formats. You can next choose to store your text on disk or cassette, but since you have just loaded the program from disk it would seem odd to wish to file the results on to tape, with all its inconvenience.

Finally you can choose from a list of printers the one you wish to use. This gives the program tremendous versatility.

Having made your choices the screen changes to put you into what is called EDIT mode. And the first pleasure is to discover that you are not stuck with the depressing initial colour scheme. By using the CTRL key and keys 1, 2 and 3 you can change the border, background and text colour to suit your own taste and mood.


REVIEW OF EASY SCRIPT
John Probert
The excellent keyboard of the CBM-64,
the recent fall in the prices of prin
and disk drives, has put word proce
within the reach of many more peop
Several not quite so expensively pr
software packages have, as a result
appeared upon the market. EASY SCRIPT
Commodore's very own word processor
the CBM-64.
To begin with the basics. What is a wo
processor? It is a software program
turns your computer and printer int

A screen shot showing EASY SCRIPT in the Edit Mode.

The manipulation of text is accomplished by the use of format instructions. These can be sprinkled throughout the text at convenient intervals, but the normal proceedure will be to bunch the main ones together at the beginning. The instructions will be displayed upon the screen, but, of course, they are not recorded upon the completed document. Each one is obtained by first using the function key F3, which places a reverse field asterisk at the start of the line. This is then followed by the format instruction.

This instruction can be one of many. It can give the document a title of your choosing, which can later be used for filing purposes. It can be used to set the margins of the paper; to justify the right margin; to centre a heading; create page numbers; decide line spacings, etc, etc.

You can make the format instructions as simple as you like for straightforward documents, and only with time and experience do you need to involve yourself in the complexities of all the rich and varied instructions that are (quite literally) at your fingertips. This means that you can put the program to use – after learning a few of the commands – from the very first day.

The topmost line of the screen display, the one above the first format instruction, is called the STATUS line, and this is entered by pressing the F1 function key. If you are tapping in text this will normally display EDIT MODE, and will also record the position of the flashing cursor in terms of lines and columns. A change of function – or MODE, as it is called – to, say, COMMAND mode to output to the printer is accomplished by pressing F1; entering O for output, followed by P for printer.

Formatted text can also be displayed upon the screen, prior to printing, and if the print format is wider than the screen (which with a 40 column screen it almost always is) you can view the entire document by scrolling back and forth and down – but with EASY SCRIPT not up!

The command mode can also be used to erase text, delete text, (yes, there is a difference), file your document, load another document, etc. But for now, back to the EDIT mode and the entering of the text itself.

Using EASY SCRIPT the CBM-64 keyboard functions for the most part just like a normal typewriter keyboard, so a trained touch-typist, having first got used to the "feel" of the keys, should have no difficulty using it. The unshifted text is displayed in lower case letters: capitals and punctuation marks are obtained in the usual way by using the shift key.

The shift lock works just like the one on a typewriter, but as an added convenience the F5 key gives you capital letters without altering the function of the other keys on the board. This is a most useful asset. The major difference from typing on a typewriter is in using the RETURN key. You do not press this at the end of a line. You just carry on typing regardless, and the cursor automatically moves to the beginning of the next screen line.

Since this is done in the middle of a word if needs be, the result can look a little odd at first, but you soon get used to it. The true line ends are decided (in accordance with the format instructions) when the text is output to the printer or screen. The RETURN key is only used at the end of a paragraph or to mark a blank line.

The common alterations to text such as corrections to spelling, removal of typing errors, the adding, deleting or changing of odd words, are all easily accomplished by the use of the normal cursor controls together with the INSERT and DELETE keys. Words and phrases can be simply typed over on the screen, taking care not to use the RETURN key as when programming, for this would wipe out the remainder of the line!

This easy method of correcting is a great boon to an enthusiastic, but inaccurate typist like myself, for I can bash away at the keys as inspiration moves me, ignoring the mistakes as they happen,

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then returning later to tidy up the whole thing. I find the constant need to resort to the correcting ribbon on my electric typewriter an inhibiting and daunting distraction.

More major alterations of text such as the removal and replacement of whole sentences or even the swapping over of complete paragraphs are best performed by using format instructions, all of which are fully detailed in the excellent manual.

There are far too many facilities to detail here, but perhaps I should mention one or two. One is called MAIL MERGE, and this allows you to send a "personalised" letter to a group of people, drawing upon what is called a FILL FILE to provide names and addresses. Myself, I dislike to receive such "personalised" letters, and consign them, unread, into the waste-paper basket; but still, I can see that is a facility that a lot of people would want from a word processor. Forms can be filled in using the TAB function (both horizontal and vertical), or what are called MEASURED BLOCKS.

Your completed (or uncompleted, for that matter) text can be easily saved as a file on to disk. It can also, as we have said, be saved on to cassette. A few disks could accommodate a large amount of material and perhaps replace those dreary filing cabinets. One step nearer to the so-called paperless office. Though, ironically enough, since I computerised a lot of my own activities I seem to be using vastly greater quantities of paper than ever before.

The final presentation of your text depends, of course, upon the quality of your printer. My dot-matrix 1515 printer, though a good work horse, leaves something to be desired when it comes to correspondence. The lack of descenders, for instance give the print a decidedly odd appearance, and, I hear, causes distress to overworked and underpaid print compositors. (no boys, please don't send the pickets round, it was just my little joke!).

Since paper may only be tractor fed you are stuck with using the usual perforated stuff, which is hardly going to create much of an impression among the punters who are going to invest money in your business. But, encouragingly, a few daisy wheel printers are starting to emerge that, while hardly discount house material, are just a little less than the cost of a motor car. Illustrated is an example of the print obtained from the new JUKI daisy wheel printer priced at well under £500. (Courtesy of Taylor Wilson Systems of Dorridge).

EASY SCRIPT contrives to work the 1515 printer without the usual annoying and irritating need to blank out the screen, though the printer does hang up occasionally; a hiatus that can only seem to be overcome by switching the printer off and on again. But this is presumably the design fault in the 64 (and one that has been strangely uncommented upon by the pundits in the magazines) and not a defect in EASY SCRIPT. One disappointment, however, is the inability of EASY SCRIPT to allow you to use any of the graphic symbols obtainable on the CBM-64 and the 1515.

To sum up. Do I like EASY SCRIPT? Yes I do, very much. Do I use it? Yes I do, all the time. I typed and corrected this article using it, and the memory of the 64 will retain it all without the need to resort to split files. One last facility to mention. Like the manual writer, throughout the review every time I wanted to type in the words EASY SCRIPT I typed in ES instead; then finally I used the SEARCH AND REPLACE command to substitute EASY SCRIPT for the abbreviation.

Any complaints? Well, for myself, only two. The inability to use the 64's graphics, which could be really useful for laying out some documents: and the price. I was relieved of £85 for my EASY SCRIPT, though I understand the going price is now £75. This is still far too much to pay for a couple of disks and a book.

I realise that development charges are heavy, but with the greater volume of sales that this program undoubtably deserves to achieve, perhaps Commodore will pursue its avowed policy of pricing to suit the pocket of a mass market.

P.S. Since writing the above paragraph, I have read that Commodore have announced one of their special offers. The price of the disk drive has been again reduced from £230 to £199, and they are throwing in EASY SCRIPT free! What can I say? Some people charge that for the word processing software alone. Go out and buy one, while, as they say, stocks last.

Word games

In spite of its name Wordpower is not just another wordprocessor. Produced by Sulis Software and distributed by John Wiley, Wordpower is an educational vocabulary and spelling package for the 64.

One of the main aims of CAL is to make learning fun. To this end Wordpower contains two games with different levels of difficulty. It is a menu driven program which makes it relatively easy to use but does presume that the user will be familiar with the words displayed on the menu.

Some of them are tough words and might challenge your average Sun reader! Menu options include, for instance, Opposites, Similies, Collectives, Synonyms, Adjectives and Nouns.

In each section of the program there is a choice between a 'game' or a 'writing' option. The game option is itself further subdivided into two choices – Lines or Shooting. Lines is a multiple choice game in which the user would be asked to match one word with another in a list of words. Britain, for instance would match with British. The Shooting game involves destroying the incorrect word by using the space bar to shoot it.

Throughout the program the screen displays are very simple. There's none of the spectacle of the arcade game though there is an obvious attempt to emulate them. Children, or even adults with reading difficulties, may find the game reasonably entertaining.

But the vocabulary is limited to 1,200 words and we must question the idea that it's enough to provide learners with a simple game. Kids these days are used to playing the most sophisticated arcade games and Wordpower won't fool them for one minute. One can imagine a child resenting the attempt to trick him into learning.

Having said that, Sulis Software have made a very honourable attempt to make learning about language as enjoyable as possible. The vast majority of CAL software works along similar lines and within that context Sulis Software's Wordpower is good.

Name: Wordpower
Company: Sulis Software, 4 Church Street, Abbey Green, Bath, Avon
Product: Educational game
Applications: Education
Documentation: Poor leaflet. Most instructions are on the cassette
Minimum hardware: 64, monitor and cassette player
Price: £9.95 plus VAT

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0446-742491.

Stack aim high

Stack Computer Services have adapted the principle of light pens and developed a Light Rifle for use with CBM 64 and Vic 20. The rifle is made of plastic and comes in a kit form. Included in the package are the necessary interfacing gadgets and a game cassette.

The television screen must be so positioned that little or no extraneous light falls on the screen. This is due to the sensitivity of the light receptor in the rifle. The rifle reacts to the light coming from the television screen and can actually distinguish differences in the colours – white and red being the most visible and blues least, so the user must create a good colour balance prior to playing any games.

Depending on the quality of picture the user will normally be able to play fast and accurate games from 8 to 12 feet away from the television set.

The actual assembly of the rifle is a simple matter. The butt clips onto the pistol unit, which houses the touch contact and light sensitivity device, just behind the hand grip. The rifle barrel slips into and locks onto the pistol barrel for easy conversion. Without the butt the rifle becomes a hand gun.

The games supplied on the cassette are: High Noon Shootout, the aim of which is to protect your land from being blown up by a gang of bandits; The Glorious Twelfth, the man in the street's opportunity to go grouse hunting. And finally, Gallery, where the user has to have fast reactions to shoot down a target as it bounces around in an open box.

The games are reasonable but not sensational and one suspects that there is potential for much better games. Our rifle worked well and, once you get used to its little idiosyncracies – the sights weren't lined up quite correctly – it is surprisingly accurate.

All in all the package is a useful and enjoyable addition to the enthusiasts collection of games paraphenalia.

Name: Stack Light Rifle.
Company: Stack Computer Services, Derby Road, Bootle, Liverpool. Tel: 051 933 5511.
Product: Light Rifle.
Applications: Games.
Documentation: Adequate leaflets.
Minimum hardware: Vic 20 or CBM 64, cassette recorder, television set.
Special Features: Kit includes a cassette containing three games which will run on both the Vic 20 and CBM 64.
Price: £29.95 including VAT.

Micro's talk back

Adman's package looks very much like an expansion cartridge and fits into the expansion port at the back of the VIC. Voice synthesisers such as Adman's package work by breaking language down into its basic sounds. One of the problems is that there are far too many of these basic sounds, or allophones, to be stored in the memory of a home computer, even with a memory as big as the Commodore 64.

The Adman Speech Synthesiser uses 64 allophones altogether and combinations of these allophones produce the words. Not all allophones can be used with all others, of course. Many combinations of consonants, for instance, would be impossible in many languages. And more than three vowels together is unlikely in English.

Each key produces a sound and the sounds are strung together to produce a word when function key F3 is pressed.

Lack of space in each operating block means that only 30 allophones can be coped with at a time. Bundles of 30 allophones or less are therefore stored using string formats. It is possible to disable the voiceback by using the RUN/STOP and RESTORE keys or by keying in SYS41009, which stops the repetition of individual keys. There are pauses of several lengths, lasting from 10 milliseconds to 200 milliseconds, which prevent words running into each other.

Allophones don't unfortunately always correspond exactly to spellings. Split into Adman allophones, for instance, the word 'answer' becomes A/N/S/ERR. This would limit the package's educational value to some extent.

So what uses might Adman's Speech Synthesiser have? It might be useful for amateur games programmers and it can certainly be a great deal of fun. Like all other speech synthesisers we have seen (or should we say heard?) it has its limitations. This is obviously a field where a great research might produce some impressive results. There are universities where exciting work is being carried out in co-operative ventures between computer departments and linguistics departments.

Meanwhile packages such as Adman's provide a useful entertainment and, for some, a useful tool.

Title: Speech Synthesiser
Company: Adman Electronics, Ripon Way, Ripon Road, Harrogate, North Yorkshire HG1 2AU. Telephone (0423) 62642
Product: Voice Synthesiser
Applications: Education and games programming
Documentation: Adequate manual with sample programs
Hardware: Unexpanded VIC (and now, we understand the 64) with TV
Price: £49.95 including VAT

Double trouble with a

Owen Murcott's practical feature about linking any two Commodore machines through their user ports continues with a two-machine game this month. If you missed the earlier articles in the series, you should write to Commodore Computing International for the back issues you need. You will then be able to start from the beginning with simple DIY instructions on how to make the connector, and how to control the user port from BASIC. You don't always have to write assembler programs to get two machines to communicate.

Looking back over this series, I see that I have only given you skeleton programs to demonstrate the principles of machine-to-machine communication through the user port. Although perhaps instructive, they are a bit boring and not of immediate use. This month I thought I would liven things up a bit by giving you a game. It is not original, but is based on one of the first games which ever appeared for the PET, named 'Wrap Trap'. I bought a copy in 1978 with my first machine. Quite simply, you and the machine try to wrap a wall around each other, causing the other to crash. In my opinion, Wrap Trap still meets all of the criteria for a good game!

Double Wrap Trap

The original version of Wrap Trap on the PET ran as 'player vs machine'. I have modified it to give you a two-machine version: player vs player. It uses the VARLINK routine from last month's article to pass variables from one machine to the other; your machine displays your opponent's moves on your screen. So you must load VARLINK first, and reset the memory limit to protect it, before you load the game.

Line 410 includes a relatively uncommon feature – the program prints an 'INSERT' character. Its function is to push the final dot into place on the screen for the matrix guide. You cannot enter an INSERT character into a program by merely pressing that key. Try it, and you will see that it just opens a gap, as usual. To obtain this character in BASIC text:

* Type the line as listed, but with a space in place of the INSERT character;
* Press RETURN;
* Move the cursor back up to that space character, press RVS ON, type a shifted 't' character;
* Press RETURN.

The reversed shifted 't', which is BASIC's encrypted 'INSERT', will remain in the text.

The listing includes alternative lines for different machines – leave out those which are not for your machine. You will see that I have suggested that you use number keys on PET, and function keys on VIC and CBM64, to control the wall-maker. The VIC function keys will not do this if you have a 'Super Expander' cartridge plugged in to expand the memory; you can only use a 3K RAM cartridge. Also you will need to adjust the layout of instructions to get a tidy appearance on the VIC screen. Use the alternative version of VARLINK (explained further on) which loads to location 7168, if you run the game on an unexpanded VIC, so that you will not run out of memory.

Wait

Look at lines 520/720 and 620/820 of DOUBLE WRAP TRAP. You will see that at one moment the machine is the master, at another it is the slave. The slave waits for the master and cannot go on until the master has communicated. Notice that the slave does not impose itself on the master; the master invites communication when it is free. From the slave's point of view, it has to wait until the master signals that it wants to talk, or that it is ready to listen.

Interrupting

Sometimes, either machine must be able to impose itself on the other, interrupt it, and demand attention. Neither is master nor slave; they are equal partners. This kind of system can best be implemented using the mechanism built in to the hardware of the microprocessor which permits it to be interrupted. The 6500 series of microprocessors used by Commodore will react to three different kinds of interrupt, created and controlled in different ways. Two of them affect data transfers on the user port, in addition to their other functions. The main one is known as IRQ (Interrupt ReQuest).

IRQ – What is it?

IRQ interrupts are constantly being created within the machine, by the clock for example. 60 times per second, or so, the clock signals the microprocessor to interrupt your program. The operating system then does various pieces of housekeeping. One of them tests whether you are pressing a key on the keyboard. If you are, the code for the key pressed is placed in the input buffer. BASIC programs are constantly being interrupted – it all happens so fast that you never notice.

When an interrupt occurs the microprocessor will:

* Stop at the end of execution of the operation currently being obeyed in your assembler program (or in the interpreter if your program is in BASIC);
* Make a note of where it had got to;
* Stop any further interrupts happening until it has . . .
* Got the address of an alternative set of instructions (the interrupt routine) and executed them to their end.

The interrupt routine is built in to ROM. At the end of it is an RTI (ReTurn from Interrupt) instruction. Its effect is to send the microprocessor back to where it originally left off in the main program,

two-machine game

which continues as though nothing had happened.

Interrupts spoil timing

There is a timing problem in assembler programs when the master machine wants to send (or get) bytes on the data link. It has to wait until the slave is listening and ready to communicate. The handshaking during this waiting period has to be very carefully timed; last month's timing diagram explained the problem. But interrupts will spoil it. Execution of the built-in interrupt routine takes an appreciable amount of time – this causes delay. If an interrupt happens at the wrong moment, the machines get out of step, and may hang up.

Don't interrupt until I've finished!

You can prevent the microprocessor from recognising an IRQ interrupt, and thereby you can eliminate the delays. The instruction to use in an assembler program is SEI. This sets the interrupt flag in the status register. (The microprocessor will also set it quite automatically when an IRQ interrupt occurs.) The normal purpose of this flag is to prevent any further interruption until the IRQ routine has been executed. Otherwise it might just go round in ever-decreasing circles! So, by setting the flag, you will disable the IRQ interrupts, and by clearing it with CLI you will re-enable them.

NMI and the Commodore 64

There is a second kind of interrupt which cannot be disabled by an SEI instruction. It is called NMI (Non-Maskable Interrupt). It has a higher priority than IRQ. Even though an IRQ interrupt may occur at the same time, NMI will take precedence. Unfortunately, the user port interface chip on the Commodore 64 can cause NMI interrupts, and SEI doesn't stop them.

Later in this article, I explain how to enable the user port to cause interrupts. On the Commodore 64, NMI interrupts from the user port chip can sometimes be enabled by routines in the operating system in ROM. You must disable them at each entry point, to ensure that they do not happen during your assembler program and introduce delays into the handshaking. The procedures for disabling are similar to those for enabling, explained later.

```
10 rem         double wrap trap                    w.owen murcott  december 1983
11 rem-------------------------------------------------------------------------
20 data 10,7,29,17,0,1,22,-1,0,60,1,0,62,0,-1,30:rem                          pet
21 data 144,240,31488,160,102,46,40,39,24,32768: rem                          pet
22 data 0,2,48,50,56: rem                                                     pet
23 poke 59468,14: rem                                                         pet
24 rem-------------------------------------------------------------------------
30 data 5,4,16,18,0,-1,30,-1,0,60,1,0,62,0,1,22: rem                          vic
31 data 788,121,7168,160,160,46,22,21,22,7680: rem                            vic
32 data 0,1,132,30720,2,6,133,136: rem                                        vic
33 poke 36879,8: print chr$(14)"<YELLOW>": rem                                vic
34 rem-------------------------------------------------------------------------
40 data 10,7,29,17,0,-1,30,-1,0,60,1,0,62,0,1,22: rem                        cbm64
41 data 788,240,39936,160,160,46,40,39,24,1024: rem                          cbm64
42 data 0,1,132,55296,2,6,133,136: rem                                       cbm64
43 poke 53280,11: poke53281,11: print chr$(14)"<YELLOW>": rem                cbm64
44 rem-------------------------------------------------------------------------
70 print "<CLS>Did you start this machine first (y/n)?
80 gosub 9000:if a$<>"y" and a$<>"n" then 80
90 ifa$="y" thenfg=1:z$="upper":u$="YOU":c$="HE":goto 100
91 fg=2:z$="lower":u$="HE":c$="YOU"
99 rem-------------------------------------------------------------------------
100 print "<CLS>    <RVS> W R A P   A R O U N D   T R A P "
120 print "<D>The object of the game is to trap your "
121 print "opponent.  Your wall-maker starts in the";
122 print z$ " part of the screen.
123 print "Control it with the keys  2 4 6 8 ": print: rem                     pet
124 print "8 - up      4 - left": rem                                         pet
125 print "2 - down    6 - right": rem                                        pet
126 print "Control it with the function keys": rem                  vic & cbm64
127 print "f1 - up     f3 - left": rem                              vic & cbm64
128 print "f7 - down   f5 - right": rem                             vic & cbm64
130 print"<D>"u$" will set the speed and start the":print"game with keys:
131 print"<D>F=Fast  M=Medium  S=Slow  Q=Quit
134 print"<D>At the game end the winner restarts the same way."
135 if fg=1 then fori=1to3000:next
199 rem-------------------------------------------------------------------------
200 for i=1 to 4: read z: next
210 dim x(4),y(4),c(4)
211 for i=1 to 4:read x(i),y(i),c(i): next
220 read ir
230 read z: for i=1 to z: p$=p$+".": next
240 read v1: v2=v1+7
241 if fg=2 then z=v1: v1=c1: c1=z:rem                                         pet
250 read v1,c1,p
260 read f,mx,my,s,z,l,n
270 read sc,vc,cc: rem                                          vic & cbm64
280 read k1,kh
290 poke ir,peek(ir)+3: if fg=2 then 350
299 rem-------------------------------------------------------------------------
300 print"<D><RVS>Speed? (f/m/s/q)
310 gosub 9000
311 if a$="f" then t1=0:goto 320
312 if a$="m" then t1=70:goto 320
313 if a$="s" then t1=150:goto 320
314 if a$<>"q" then 310
315 t1=-1
320 sys v2,t1:goto 400
350 print"<D><RVS>Opponent sets speed
360 sys v1
399 rem-------------------------------------------------------------------------
400 if t1=-1 then poke ir,peek(ir)-3: print"<CLS>": end
410 print "<CLS>";p$;p$;p$;p$;left$(p$,mx)"<L><INS>.";
420 ud=3: cd=2: c=0
430 restore: read ux,uy,cx,cy
440 ua=s+ux+f*uy: ca=s+cx+f*cy
450 get a$:if a$<>"" then 450
460 if fg=2 then 720
499 rem-------------------------------------------------------------------------
500 get a$:if a$<chr$(k1) or a$>chr$(kh) then 520
510 d=(asc(a$)-n)/l:if int(d)=d then ud=d
520 sys v2,ud
530 gosub 9070
540 gosub 9040
620 sys v1
630 gosub 9080
650 on c+1 goto 500,1000,1100,1200
699 rem-------------------------------------------------------------------------
720 sys v1
730 gosub 9070
800 get a$:if a$<chr$(k1) or a$>chr$(kh) then 820
810 d=(asc(a$)-n)/l:if int(d)=d then cd=d
820 sys v2,cd
830 gosub 9080
840 gosub 9040
850 on c+1 goto 720,1000,1100,1200
899 rem-------------------------------------------------------------------------
```

A mistake

The intent of this series of articles is to share my discoveries and the results of practical experiment. But because it is about experiments, it is also about mistakes.

In last month's versions of MEMLINK and VARLINK the interrupts are disabled while the master is awaiting the slave. Then they are re-instated so that the STOP key can be detected during execution of those machine code routines. This permits you to use the key to quit the machine code if necessary. When writing the Double Wrap Trap game for this month's article, I found that it would generally work, but would occasionally hang up. I could press STOP and abort the program, but then I couldn't continue. Eventually I traced the problem to the occurrence of an interrupt during the transfer of the bytes of a variable. It caused the handshaking to get out of step.

MEMLINK and VARLINK

Both MEMLINK and VARLINK are affected by the interrupt timing problem, but not my earlier PROGLINK routine. This month, I have given you a revised version of these two routines which will not hang up. There was no point in wasting space by giving the loader again, so I have omitted it and have just given the DATA statements. You can use the same loader as before.

There are two revised versions of VARLINK for the VIC. One will sit alongside MEMLINK, as in the previous version. The alternative version loads to the same locations as MEMLINK. (The first number in each group of statements is the start address of the routine; the second is a sumcheck.) I have provided the alternative version to use with 'Double Wrap Trap' on an unexpanded VIC.

Precautions

My conclusion, after fixing my mistake, is that it is a wise precaution in assembler programs to disable the interrupts for the whole duration of a data transfer on the user port. You need to:

* Disable IRQ interrupts with SEI;
* Stop the chip from causing further interrupts by storing the appropriate value in the Interrupt Enable Register (defined later).

Using SEI has the unfortunate side-effect of making the machine slightly less responsive to the keyboard. You may have to hold keys down for a moment,

```
1000 cs=cs+1:print"{CLS}{RVS} "u$";:gosub 9090:on fg goto 350,300
1100 us=us+1:print"{CLS}{RVS} "c$";:gosub 9090:on fg goto 300,350
1200 us=us+2:cs=cs+2
1201 poke a,214
1202 print"{CLS}{RVS} B O T H";:gosub 9090:on fg goto 300,350
1999 rem-----------------------------------------------------------------------
9000 get a$:if a$<>"" then 9000
9001 get a$:if a$="" then 9001
9002 return
9009 rem-----------------------------------------------------------------------
9030 x=x+x(d):y=y+y(d)
9031 if x<z then x=mx
9032 if x>mx then x=z
9033 if y<z then y=my
9034 if y>my then y=z
9035 a=s+x+f*y
9036 return
9039 rem-----------------------------------------------------------------------
9040 if t1 then for i=1 to t1:next
9041 return
9049 rem-----------------------------------------------------------------------
9070 x=ux:y=uy:d=ud:gosub 9030
9071 if peek(a)<>p then c=c+1
9072 poke ua,ul
9073 poke ua+sc,uc: rem                                          vic & cbm64
9074 poke a,c(ud)
9075 poke a+sc,uc: rem                                          vic & cbm64
9076 ua=a:ux=x:uy=y
9077 return
9079 rem-----------------------------------------------------------------------
9080 x=cx:y=cy:d=cd:gosub 9030
9081 if peek(a)<>p then c=c+2
9082 poke ca,cl
9083 poke ca+sc,cc: rem                                          vic & cbm64
9084 poke a,c(cd)
9085 poke a+sc,cc: rem                                          vic & cbm64
9086 ca=a:cx=x:cy=y
9087 return
9089 rem-----------------------------------------------------------------------
9090 print"   C R A S H E D ! "
9091 print"                {LLLLLLLLLLLLLLLL}"u$"="us;c$"="cs
9092 return
9099 rem-----------------------------------------------------------------------
```

```
READY.
 1000 ;*****************************************************************************
 1010 ;
 1020 ;SPECIMEN ASSEMBLER SOURCE CODE  -  PET BASIC4
 1030 ;DEMONSTRATES RE-DIRECTION OF IRQ
 1040 ;
 1050 ;*****************************************************************************
 1060         ;
 1070         ;                PAGE ZERO LOCATIONS
 1080 CINV    =$90            ;RAM IRQ POINTER
 1090         ;
 1100         ;                ROM LOCATIONS
 1110 IRQEND =$E600           ;IRQ ENDING ROUTINE
 1120         ;
 1130         ;                CHIP REGISTERS
 1140 IC      =$E84D          ;INTERRUPT FLAG
 1150 IE      =$E84E          ;INTERRUPT ENABLE
 1160         ;
 1170         ;                PROGRAM CONSTANTS
 1180 INTDIS =2               ;TO DISABLE INTERRUPTS
 1190 INTEN  =130             ;TO ENABLE INTERRUPTS
 1200         ;                ALSO TO TEST INTERRUPT FLAG
 1210 ;*****************************************************************************
 1220         ;                ENTRY POINT TO RE-DIRECT RAM IRQ POINTERS
 1230 ENABL   LDA CINV        ;LO IRQ POINTER PRESENT VALUE
 1240         STA IRQST       ;SAVE IT IN RESERVED BYTES
 1250         LDA CINV+1      ;HI
 1260         STA IRQST+1
 1270         SEI             ;DISABLE INTERRUPTS
 1280         LDA #<OWNCDE    ;LO START OF OWN CODE
 1290         STA CINV        ;RESET RAM POINTER
 1300         LDA #>OWNCDE    ;HI
 1310         STA CINV+1
 1320         LDA #INTEN
 1330         STA IE          ;TO ENABLE CHIP TO INTERRUPT
 1340         CLI             ;RE-ENABLE INTERRUPTS
 1350         RTS             ;AND RETURN
 1360 ;*****************************************************************************
 1370         ;                ENTRY POINT TO RESTORE RAM IRQ POINTERS
 1380 DISABL  SEI             ;DISABLE INTERRUPTS
 1390         LDA #INTDIS
 1400         STA IE          ;TO STOP CHIP FROM INTERRUPTING
 1410         LDA IRQST       ;SAVED LO IRQ POINTER VALUE
 1420         STA CINV        ;RESTORE RAM POINTER
 1430         LDA IRQST+1     ;HI
 1440         STA CINV+1
```

rather than just touching them. Also, the STOP key won't work. If a 'STOP' feature is necessary in your assembler program, it must test the key periodically itself. You cannot depend on the keyboard scan included within the interrupt routine in ROM, because it will never be entered. Instead, you must use the entry points which that routine uses. Your assembler program should perform the following subroutine calls (true for PET, VIC and 64):

* JSR $FFEA Updates TI clock and gets keypress
* JSR $FFE1 Tests STOP key pressed and, if so, sets the Z flag. BEQ to your STOP exit.

The User Port can interrupt

It is possible to enable the user port interface chip to create an interrupt when the chip receives a handshake signal. By doing this, you can remove the need for your program to await the signal. Instead, the program will get on with something else, and will only be interrupted when a handshake is received, signifying that the other machine wishes to communicate. At this point, further interrupts will be disabled by the microprocessor, your own interrupt routine will be entered, and this will handle the data transfer imposed by the other machine.

One example of how you could use the ability to interrupt is to permit two machines to share a disk drive. One machine is connected directly to it. The other accesses the disks through the first machine, and communicates via the user port. When the extension machine requires to write to a disk, it interrupts and transfers its data to the main machine. Your interrupt routine in this machine then writes to the disk. The main program is temporarily halted while this happens, and as soon as the transfer is finished it continues from where it left off.

Enable and disable

To enable the chip to interrupt the microprocessor when a handshake is received, you have to set certain bits in the Interrupt Enable Register (IE for short). By clearing them, you will disable this ability. Here are the addresses and values to store:

	IE address	Value to enable	Value to disable
* PET	59470	130	2
* VIC	37150	140	16
* 64	56589	140	16

```
1450        CLI             ;RE-ENABLE INTERRUPTS
1460        RTS             ;AND RETURN
1470 ;*************************************************************************
1480        ;                ENTRY POINT WHEN AN INTERRUPT OCCURS
1490 OWNCDE LDA IC          ;INTERRUPT CONTROL
1500        TAX             ;TO SAVE IT (ONLY NEEDED FOR CBM64)
1510        AND #INTEN      ;IRQ AND HANDSHAKE FLAGS
1520        CMP #INTEN
1530        BEQ OWNIRQ      ;THEY ARE BOTH SET
1540        JMP (IRQST)     ;GO ON TO NORMAL IRQ ENTRY
1550        ;
1560 OWNIRQ ;                THIS IS WHERE YOUR OWN CODING SITS
1570        ;
1580        JMP IRQEND      ;TO TIDY UP AT THE END
1590 ;*************************************************************************
1600        ;                RESERVED BYTES
1610 IRQST  .BYT 0,0        ;FOR SAVING PRESENT RAM IRQ POINTER VALUE
1620 ;*************************************************************************
1630 .END
```

```
59998 REM MEMLINK                    W.OWEN MURCOTT          REV.DEC 1983
59999 REM-------------------------------------------------------------------
60000 DATA 32000, 41037: REM                                      PET BASIC2
60010 DATAA 9,00,85,00,4C,38,7D,A9,4D,D0,02,A9,CD,85,00,20,27,7E,A5,12,48,A5,11
60020 DATA 48,20,27,7E,A5,12,48,A5,11,48,20,27,7E,A5,11,85,4F,A5,12,85,50,68,85
60030 DATA 4D,68,85,4E,68,85,4B,68,85,4C,A9,00,8D,4B,E8,AD,4C,E8,29,FE,8D,4C,E8
60040 DATA AD,4C,E8,09,E0,8D,4C,E8,A9,02,8D,4E,E8,78,AD,41,E8,AD,4C,E8,09,E0,8D
60050 DATA 4C,E8,A5,00,D0,1B,8D,43,E8,20,0B,7E,A0,07,88,D0,FD,AD,4D,E8,29,02,F0
60060 DATA F1,AD,41,E8,A2,00,A0,06,D0,30,AD,4D,E8,29,02,F0,02,D0,09,AD,4D,E8,29
60070 DATA 02,F0,F0,D0,00,AD,4C,E8,29,DF,8D,4C,E8,AE,41,E8,09,E0,8D,4C,E8,A9,FF
60080 DATA 8D,43,E8,A2,00,A0,06,D0,18,20,0B,7E,20,1C,7E,95,4B,E8,88,D0,F4,20,19
60090 DATA 7E,C9,4D,D0,22,F0,39,20,1C,7E,B5,4B,8D,41,E8,20,0B,7E,E8,88,D0,F1,20
60100 DATA 1C,7E,A5,00,48,8D,41,E8,20,0B,7E,68,C9,4D,D0,19,A9,FF,8D,43,E8,A0,00
60110 DATA 20,1C,7E,B1,4B,8D,41,E8,20,0B,7E,20,44,7E,90,F0,58,60,A9,00,8D,43,E8
60120 DATA A0,00,20,19,7E,91,4F,20,3E,7E,90,F6,58,60,AD,4C,E8,29,DF,8D,4C,E8,09
60130 DATA E0,8D,4C,E8,60,20,0B,7E,AD,4D,E8,29,02,F0,F9,AD,41,E8,60,20,F8,CD,20
60140 DATA 9F,CC,A5,07,D0,08,A5,08,D0,03,20,D2,D6,60,A2,A3,4C,57,C3,E6,4F,D0,02
60150 DATA E6,50,A5,4C,C5,4E,90,08,D0,0C,A5,4B,C5,4D,B0,06,E6,4B,D0,02,E6,4C,60
60160 DATA *
60200 DATA 32000, 40923: REM                                      PET BASIC4
60210 DATA A9,00,85,00,4C,38,7D,A9,4D,D0,02,A9,CD,85,00,20,27,7E,A5,12,48,A5,11
60220 DATA 48,20,27,7E,A5,12,48,A5,11,48,20,27,7E,A5,11,85,4F,A5,12,85,50,68,85
60230 DATA 4D,68,85,4E,68,85,4B,68,85,4C,A9,00,8D,4B,E8,AD,4C,E8,29,FE,8D,4C,E8
60240 DATA AD,4C,E8,09,E0,8D,4C,E8,A9,02,8D,4E,E8,78,AD,41,E8,AD,4C,E8,09,E0,8D
60250 DATA 4C,E8,A5,00,D0,1B,8D,43,E8,20,0B,7E,A0,07,88,D0,FD,AD,4D,E8,29,02,F0
60260 DATA F1,AD,41,E8,A2,00,A0,06,D0,30,AD,4D,E8,29,02,F0,02,D0,09,AD,4D,E8,29
60270 DATA 02,F0,F0,D0,00,AD,4C,E8,29,DF,8D,4C,E8,AE,41,E8,09,E0,8D,4C,E8,A9,FF
60280 DATA 8D,43,E8,A2,00,A0,06,D0,18,20,0B,7E,20,1C,7E,95,4B,E8,88,D0,F4,20,19
60290 DATA 7E,C9,4D,D0,22,F0,39,20,1C,7E,B5,4B,8D,41,E8,20,0B,7E,E8,88,D0,F1,20
60300 DATA 1C,7E,A5,00,48,8D,41,E8,20,0B,7E,68,C9,4D,D0,19,A9,FF,8D,43,E8,A0,00
60310 DATA 20,1C,7E,B1,4B,8D,41,E8,20,0B,7E,20,44,7E,90,F0,58,60,A9,00,8D,43,E8
60320 DATA A0,00,20,19,7E,91,4F,20,3E,7E,90,F6,58,60,AD,4C,E8,29,DF,8D,4C,E8,09
60330 DATA E0,8D,4C,E8,60,20,0B,7E,AD,4D,E8,29,02,F0,F9,AD,41,E8,60,20,F5,BE,20
60340 DATA 98,BD,A5,07,D0,08,A5,08,D0,03,20,2D,C9,60,A2,A3,4C,CF,B3,E6,4F,D0,02
60350 DATA E6,50,A5,4C,C5,4E,90,08,D0,0C,A5,4B,C5,4D,B0,06,E6,4B,D0,02,E6,4C,60
60360 DATA *
60400 DATA 7168, 35378: REM                                           VIC
60410 DATA A9,00,85,00,4C,38,1C,A9,4D,D0,02,A9,CD,85,00,20,27,1D,A5,15,48,A5,14
60420 DATA 48,20,27,1D,A5,15,48,A5,14,48,20,27,1D,A5,14,85,52,A5,15,85,53,68,85
60430 DATA 50,68,85,51,68,85,4E,68,85,4F,A9,00,8D,1B,91,AD,1C,91,29,EF,8D,1C,91
60440 DATA AD,1C,91,09,E0,8D,1C,91,A9,10,8D,1E,91,78,AD,10,91,AD,1C,91,09,E0,8D
60450 DATA 1C,91,A5,00,D0,1B,8D,12,91,20,0B,1D,A0,07,88,D0,FD,AD,1D,91,29,10,F0
60460 DATA F1,AD,10,91,A2,00,A0,06,D0,30,AD,1D,91,29,10,F0,02,D0,09,AD,1D,91,29
60470 DATA 10,F0,F0,D0,00,AD,1C,91,29,DF,8D,1C,91,AE,10,91,09,E0,8D,1C,91,A9,FF
60480 DATA 8D,12,91,A2,00,A0,06,D0,18,20,0B,1D,20,1C,1D,95,4E,E8,88,D0,F4,20,19
60490 DATA 1D,C9,4D,D0,22,F0,39,20,1C,1D,B5,4E,8D,10,91,20,0B,1D,E8,88,D0,F1,20
60500 DATA 1C,1D,A5,00,48,8D,10,91,20,0B,1D,68,C9,4D,D0,19,A9,FF,8D,12,91,A0,00
60510 DATA 20,1C,1D,B1,4E,8D,10,91,20,0B,1D,20,44,1D,90,F0,58,60,A9,00,8D,12,91
60520 DATA A0,00,20,19,1D,91,52,20,3E,1D,90,F6,58,60,AD,1C,91,29,DF,8D,1C,91,09
60530 DATA E0,8D,1C,91,60,20,0B,1D,AD,1D,91,29,10,F0,F9,AD,10,91,60,20,FD,CE,20
60540 DATA 9E,CD,A5,0D,D0,08,A5,0E,D0,03,20,F7,D7,60,A2,15,4C,3A,C4,E6,52,D0,02
60550 DATA E6,53,A5,4F,C5,51,90,08,D0,0C,A5,4E,C5,50,B0,06,E6,4E,D0,02,E6,4F,60
60560 DATA *
60600 DATA 40448, 38389: REM                                         CBM64
60610 DATA A9,00,85,BD,4C,38,9E,A9,4D,D0,02,A9,CD,85,BD,20,27,9F,A5,15,48,A5,14
60620 DATA 48,20,27,9F,A5,15,48,A5,14,48,20,27,9F,A5,14,85,52,A5,15,85,53,68,85
60630 DATA 50,68,85,51,68,85,4E,68,85,4F,A9,00,8D,00,08,AD,00,08,29,00,8D,00,08
60640 DATA AD,02,DD,09,04,8D,02,DD,A9,7F,8D,0D,DD,78,AD,0D,DD,AD,00,DD,09,04,8D
60650 DATA 00,DD,A5,BD,D0,1B,8D,03,DD,20,0B,9F,A0,06,88,D0,FD,AD,0D,DD,29,10,F0
60660 DATA F1,AD,0D,DD,A2,00,A0,06,D0,30,AD,0D,DD,29,10,F0,02,D0,09,AD,0D,DD,29
60670 DATA 10,F0,F0,D0,00,AD,00,DD,29,F8,8D,00,DD,AE,0D,DD,09,04,8D,00,DD,A9,FF
60680 DATA 8D,03,DD,A2,00,A0,06,D0,18,20,0B,9F,20,1C,9F,95,4E,E8,88,D0,F4,20,19
60690 DATA 9F,C9,4D,D0,22,F0,39,20,1C,9F,B5,4E,8D,01,DD,20,0B,9F,E8,88,D0,F1,20
60700 DATA 1C,9F,A5,BD,48,8D,01,DD,20,0B,9F,68,C9,4D,D0,19,A9,FF,8D,03,DD,A0,00
60710 DATA 20,1C,9F,B1,4E,8D,01,DD,20,0B,9F,20,44,9F,90,F0,58,60,A9,00,8D,03,DD
60720 DATA A0,00,20,19,9F,91,52,20,3E,9F,90,F6,58,60,AD,00,DD,29,F8,8D,00,DD,09
60730 DATA 04,8D,00,DD,60,20,0B,9F,AD,0D,DD,29,10,F0,F9,AD,01,DD,60,20,FD,AE,20
60740 DATA 9E,AD,A5,0D,D0,08,A5,0E,D0,03,20,F7,B7,60,A2,15,4C,3A,A4,E6,52,D0,02
60750 DATA E6,53,A5,4F,C5,51,90,08,D0,0C,A5,4E,C5,50,B0,06,E6,4E,D0,02,E6,4F,60
60760 DATA *
```

You also need to do some other things so that your interrupt routine can be entered when an interrupt occurs. It involves re-directing IRQ (PET and VIC), or NMI (Commodore 64).

Redirecting interrupts

The addresses of the start of the IRQ and NMI interrupt routines in ROM are found at fixed locations in ROM on all Commodore machines. You may recall that programs in earlier articles got the address from the IRQ location and used it for machine identification – it varies from machine to machine. The microprocessor is constructed to get it automatically when an IRQ interrupt occurs. The same is true for NMI. But the trail of instructions soon breaks, and continues from a point whose address is held in RAM. Normally the address points straight back into the ROM. Because the pointer is in RAM, you can change its contents to point elsewhere.

Line 290 of 'Double Wrap Trap' actually redirects the interrupts and thereby disables the STOP key (it is restored at line 400). It changes the LO address in the RAM IRQ pointer to make it point to the location just three bytes further on past its normal re-entry point. So it skips the subroutine jump, a three-byte instruction, at that point within the IRQ routine. This jump is to the subroutine, mentioned earlier, which updates the TI clock and tests to see if the STOP key is currently depressed.

The trick of re-directing IRQ to disable 'STOP' seems to work for all Commodore machines. Unfortunately it also stops the TI clock, which your program may access, as this is updated before the STOP key test and in the same routine. It does not work on a VIC with a 'Super Expander' cartridge plugged in. IRQ is already re-directed elsewhere.

BASIC is slow. You can only alter one byte of the IRQ point from BASIC with a POKE command. This is enough for disabling the STOP key. If you tried to alter both bytes to point to a new LO-HI address, an interrupt would probably occur before the second POKE could be executed and the machine would crash. So you have to do that from an assembler program.

The interrupt trail

I pointed out earlier that NMI is the user port interrupt on the Commodore 64. PET and VIC use IRQ. Here are their trails. I suggest that you use a monitor cartridge, or 'Extramon' (or its equivalent) to follow the trail and see what happens at each point:

	ROM Pointer at	Points to start	Then RAM Pointer at	Points to main	Routine ends at
*PET BASIC2	$FFFE-F	$E616	$90-$91	$E62E	$E6E4
* PET BASIC4	$FFFE-F	$E442	$90-$91	$E455	$E600
* VIC	$FFFE-F	$FF72	$0314-$0315	$EABF	$EB19
* 64	$FFFA-B	$FE43	$0318-$0319	$FE47	$FEBC

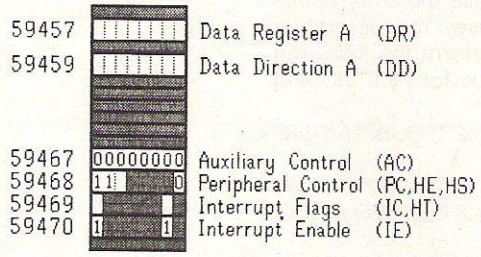

Fig 1 – PET User Port Chip

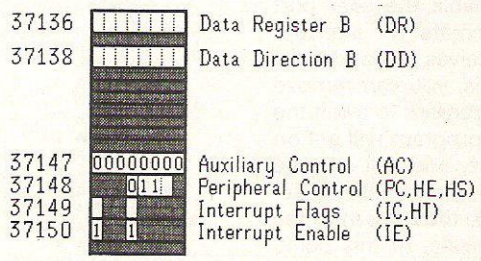

Fig 2 – VIC User Port Chip

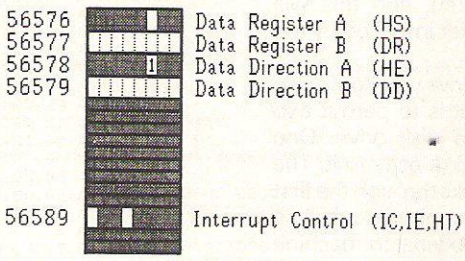

Fig 3 – CBM64 User Port Chip

```
59998 REM VARLINK                    W.OWEN MURCOTT          REV. DEC 1983
59999 REM-------------------------------------------------------------------
60000 DATA 31488, 57815: REM                                      PET BASIC2
60010 DATA A9,00,85,00,4C,19,7B,A9,56,D0,02,A9,D6,85,00,20,F8,CD,20,6D,CF,85,46
60020 DATA 84,47,A9,00,8D,4B,E8,AD,4C,E8,29,FE,8D,4C,E8,AD,4C,E8,09,E0,8D,4C,E8
60030 DATA 7B,A9,02,8D,4E,E8,AD,41,E8,AD,4C,E8,09,E0,8D,4C,E8,A5,00,D0,18,8D,43
60040 DATA E8,20,B0,7C,A0,07,88,D0,FD,AD,4D,E8,29,02,F0,F1,AD,41,E8,4C,85,7B,AD
60050 DATA 4D,E8,29,02,F0,02,D0,09,AD,4D,E8,29,02,F0,F0,D0,00,AD,4C,E8,29,DF,8D
60060 DATA 4C,E8,AE,41,E8,09,E0,8D,4C,E8,A9,FF,8D,43,E8,4C,AF,7B,20,C1,7C,48,20
60070 DATA BE,7C,85,07,20,BE,7C,85,08,20,BE,7C,85,42,20,BE,7C,85,43,A9,00,85,06
60080 DATA 20,C9,CF,85,46,84,47,68,C9,56,D0,30,F0,6D,A5,00,8D,41,E8,20,BE,7C,A5
60090 DATA 07,8D,41,E8,20,BE,7C,A5,08,8D,41,E8,20,BE,7C,A5,42,8D,41,E8,20,BE,7C
60100 DATA A5,43,8D,41,E8,20,B0,7C,A5,00,C9,56,D0,3F,A9,FF,8D,43,E8,A5,07,D0,09
60110 DATA A2,05,20,D6,7C,A0,00,F0,0F,A0,02,B1,44,85,20,88,B1,44,85,1F,88,B1,44
60120 DATA AA,20,C1,7C,8E,41,E8,20,B0,7C,E0,00,F0,0F,20,C1,7C,B1,1F,8D,41,E8,20
60130 DATA B0,7C,C8,CA,D0,F1,58,60,A9,00,8D,43,E8,20,BE,7C,AA,A0,00,A5,07,D0,08
60140 DATA 20,D6,7C,20,CC,7C,58,60,86,1F,38,A5,30,E5,1F,85,30,A5,31,E9,00,85,31
60150 DATA 38,A5,30,E9,02,85,30,85,32,85,1F,85,40,A5,31,E9,00,85,31,85,33,85,20
60160 DATA 85,41,C5,2F,90,0A,D0,0B,A5,30,C5,2E,90,02,D0,03,4C,55,C3,E0,00,F0,03
60170 DATA 20,CC,7C,98,18,65,1F,85,1F,90,02,E6,20,A0,00,A9,2C,91,1F,85,04,A9,3A
60180 DATA 85,03,A9,98,85,0B,A5,77,A4,78,85,48,84,49,A5,40,A4,41,85,77,84,78,20
60190 DATA 67,D3,20,BD,D6,20,E2,C8,A5,48,A4,49,85,77,84,78,58,60,AD,4C,E8,29,DF
60200 DATA 8D,4C,E8,09,E0,8D,4C,E8,60,20,B0,7C,AD,4D,E8,29,02,F0,F9,AD,41,E8,60
60210 DATA 20,BE,7C,91,1F,C8,CA,D0,F7,60,A5,44,85,1F,A5,45,85,20,60
60220 DATA *
60300 DATA 31488, 57488: REM                                      PET BASIC4
60310 DATA A9,00,85,00,4C,19,7B,A9,56,D0,02,A9,D6,85,00,20,F5,BE,20,2B,C1,85,46
60320 DATA 84,47,A9,00,8D,4B,E8,AD,4C,E8,29,FE,8D,4C,E8,AD,4C,E8,09,E0,8D,4C,E8
```

Add your own

You can change the RAM pointers to point to your own user port routines, written in assembler, which will then be executed each time an interrupt occurs. When you change the pointers, you must disable IRQ interrupts first, using SEI. It would be disastrous if an interrupt happened before the change was completed. Be systematic and preserve the present content of the pointers so that they can be restored. Then re-enable interrupts with CLI.

I have given some sample code, labelled 'IRQLINK', at the end of this article which shows how to do it. It allows your own interrupt routines to be enabled/disabled at will by using alternative entry points 'ENABL' and 'DISABL'.

Beware of cassette tape transfers. They sometimes have a nasty habit of not working if the IRQ pointers do not have their normal values at the start. Also they reset the pointers back to their normal values at the end. Then your interrupt routine will never be entered. So avoid cassette tape usage if you alter the pointers, or make sure that you reset them before and after tape transfers. I have not yet had a chance to find all of the 'nasties' which lie in store for you with NMI pointers on the CBM64.

What to do on interrupt

Once you have redirected the interrupt trail to run through your own routine, remember that all interrupts will follow it. You need to be able to distinguish those which have come from the user port interface chip, and those which have arisen from other sources. The latter must be immediately redirected back to the normal interrupt processing in ROM.

If the interrupt has stemmed from the user port interface chip, bit 7 of the Interrupt Flag Register (Interrupt Control Register on the Commodore 64) will be set. When it is caused by a handshake, the appropriate interrupt flag will also be set in that register. Logical AND, using the value for enabling the interrupt (see above), will detect it (look at label 'OWNCDE' in my sample code with this article). You can then take action accordingly, and when it is complete go on to the interrupt end address in ROM where the stack is tidied (given above).

```
60330 DATA 78,A9,02,8D,4E,E8,AD,41,E8,AD,4C,E8,09,E0,8D,4C,E8,A5,00,D0,18,8D,43
60340 DATA E8,20,B0,7C,A0,07,88,D0,FD,AD,4D,E8,29,02,F0,F1,AD,41,E8,4C,85,7B,AD
60350 DATA 4D,E8,29,02,F0,02,D0,09,AD,4D,E8,29,02,F0,F0,D0,00,AD,4C,E8,29,DF,8D
60360 DATA 4C,E8,AE,41,E8,09,E0,8D,4C,E8,A9,FF,8D,43,E8,4C,AF,7B,20,C1,7C,48,20
60370 DATA BE,7C,85,07,20,BE,7C,85,08,20,BE,7C,85,42,20,BE,7C,85,43,A9,00,85,06
60380 DATA 20,87,C1,85,46,84,47,68,C9,56,D0,30,F0,6D,A5,00,8D,41,E8,20,BE,7C,A5
60390 DATA 07,8D,41,E8,20,BE,7C,A5,08,8D,41,E8,20,BE,7C,A5,42,8D,41,E8,20,BE,7C
60400 DATA A5,43,8D,41,E8,20,B0,7C,A5,00,C9,56,D0,3F,A9,FF,8D,43,E8,A5,07,D0,09
60410 DATA A2,05,20,D6,7C,A0,00,F0,0F,A0,02,B1,44,85,20,88,B1,44,85,1F,88,B1,44
60420 DATA AA,20,C1,7C,8E,41,E8,20,B0,7C,E0,00,F0,0F,20,C1,7C,B1,1F,8D,41,E8,20
60430 DATA B0,7C,C8,CA,D0,F1,58,60,A9,00,8D,43,E8,20,BE,7C,AA,A0,00,A5,07,D0,08
60440 DATA 20,D6,7C,20,CC,7C,58,60,86,1F,38,A5,30,E5,1F,85,30,A5,31,E9,00,85,31
60450 DATA 38,A5,30,E9,02,85,30,85,32,85,1F,85,40,A5,31,E9,00,85,31,85,33,85,20
60460 DATA 85,41,C5,2F,90,0A,D0,0B,A5,30,C5,2E,90,02,D0,03,4C,CD,B3,E0,00,F0,03
60470 DATA 20,CC,7C,98,18,65,1F,85,1F,90,02,E6,20,A0,00,A9,2C,91,1F,85,04,A9,3A
60480 DATA 85,03,A9,98,85,0B,A5,77,A4,78,85,48,84,49,A5,40,A4,41,85,77,84,78,20
60490 DATA B6,C5,20,18,C9,20,65,B9,A5,48,A4,49,85,77,84,78,58,60,AD,4C,E8,29,DF
60500 DATA 8D,4C,E8,09,E0,8D,4C,E8,60,20,B0,7C,AD,4D,E8,29,02,F0,F9,AD,41,E8,60
60510 DATA 20,BE,7C,91,1F,C8,CA,D0,F7,60,A5,44,85,1F,A5,45,85,20,60
60520 DATA *


10 REM      VARLINK      W.OWEN MURCOTT                          REV. DEC 1983
59999 REM------------------------------------------------------------------------
60600 DATA 7168, 51350: REM                  VIC - ALTERNATIVE VERSION OF VARLINK
60610 DATA A9,00,85,00,4C,19,1C,A9,56,D0,02,A9,D6,85,00,20,FD,CE,20,8B,D0,85,49
60620 DATA 84,4A,A9,00,8D,1B,91,AD,1C,91,29,EF,8D,1C,91,AD,1C,91,09,E0,8D,1C,91
60630 DATA 78,A9,10,8D,1E,91,AD,10,91,AD,1C,91,09,E0,8D,1C,91,A5,00,D0,18,8D,12
60640 DATA 91,20,B0,1D,A0,07,88,D0,FD,AD,1D,91,29,10,F0,F1,AD,10,91,4C,85,1C,AD
60650 DATA 1D,91,29,10,F0,02,D0,09,AD,1D,91,29,10,F0,F0,D0,00,AD,1C,91,29,DF,8D
60660 DATA 1C,91,AE,10,91,09,E0,8D,1C,91,A9,FF,8D,12,91,4C,AF,1C,20,C1,1D,48,20
60670 DATA BE,1D,85,0D,20,BE,1D,85,0E,20,BE,1D,85,45,20,BE,1D,85,46,A9,00,85,0C
60680 DATA 20,E7,D0,85,49,84,4A,68,C9,56,D0,30,F0,6D,A5,00,8D,10,91,20,BE,1D,A5
60690 DATA 0D,8D,10,91,20,BE,1D,A5,0E,8D,10,91,20,BE,1D,A5,45,8D,10,91,20,BE,1D
60700 DATA A5,46,8D,10,91,20,B0,1D,A5,00,C9,56,D0,3F,A9,FF,8D,12,91,A5,0D,D0,09
60710 DATA A2,05,20,D6,1D,A0,00,F0,0F,A0,02,B1,47,85,23,88,B1,47,85,22,88,B1,47
60720 DATA AA,20,C1,1D,8E,10,91,20,B0,1D,E0,00,F0,0F,20,C1,1D,B1,22,8D,10,91,20
60730 DATA B0,1D,C8,CA,D0,F1,58,60,A9,00,8D,12,91,20,BE,1D,AA,A0,00,A5,0D,D0,08
60740 DATA 20,D6,1D,20,CC,1D,58,60,86,22,38,A5,33,E5,22,85,33,A5,34,E9,00,85,34
60750 DATA 38,A5,33,E9,02,85,33,85,35,85,22,85,43,A5,34,E9,00,85,34,85,36,85,23
60760 DATA 85,44,C5,32,90,0A,D0,0B,A5,33,C5,31,90,02,D0,03,4C,35,C4,E0,00,F0,03
60770 DATA 20,CC,1D,98,18,65,22,85,22,90,02,E6,23,A0,00,A9,2C,91,22,85,08,A9,3A
60780 DATA 85,07,A9,98,85,11,A5,7A,A4,7B,85,4B,84,4C,A5,43,A4,44,85,7A,84,7B,20
60790 DATA 8D,D4,20,E2,D7,20,DA,C9,A5,4B,A4,4C,85,7A,84,7B,58,60,AD,1C,91,29,DF
60800 DATA 8D,1C,91,09,E0,8D,1C,91,60,20,B0,1D,AD,1D,91,29,10,F0,F9,AD,10,91,60
60810 DATA 20,BE,1D,91,22,C8,CA,D0,F7,60,A5,47,85,22,A5,48,85,23,60
60820 DATA *


60600 DATA 6656, 51300: REM                                              VIC
60610 DATA A9,00,85,00,4C,19,1A,A9,56,D0,02,A9,D6,85,00,20,FD,CE,20,8B,D0,85,49
60620 DATA 84,4A,A9,00,8D,1B,91,AD,1C,91,29,EF,8D,1C,91,AD,1C,91,09,E0,8D,1C,91
60630 DATA 78,A9,10,8D,1E,91,AD,10,91,AD,1C,91,09,E0,8D,1C,91,A5,00,D0,18,8D,12
60640 DATA 91,20,B0,1B,A0,07,88,D0,FD,AD,1D,91,29,10,F0,F1,AD,10,91,4C,85,1A,AD
60650 DATA 1D,91,29,10,F0,02,D0,09,AD,1D,91,29,10,F0,F0,D0,00,AD,1C,91,29,DF,8D
60660 DATA 1C,91,AE,10,91,09,E0,8D,1C,91,A9,FF,8D,12,91,4C,AF,1A,20,C1,1B,48,20
60670 DATA BE,1B,85,0D,20,BE,1B,85,0E,20,BE,1B,85,45,20,BE,1B,85,46,A9,00,85,0C
60680 DATA 20,E7,D0,85,49,84,4A,68,C9,56,D0,30,F0,6D,A5,00,8D,10,91,20,BE,1B,A5
60690 DATA 0D,8D,10,91,20,BE,1B,A5,0E,8D,10,91,20,BE,1B,A5,45,8D,10,91,20,BE,1B
60700 DATA A5,46,8D,10,91,20,B0,1B,A5,00,C9,56,D0,3F,A9,FF,8D,12,91,A5,0D,D0,09
60710 DATA A2,05,20,D6,1B,A0,00,F0,0F,A0,02,B1,47,85,23,88,B1,47,85,22,88,B1,47
60720 DATA AA,20,C1,1B,8E,10,91,20,B0,1B,E0,00,F0,0F,20,C1,1B,B1,22,8D,10,91,20
60730 DATA B0,1B,C8,CA,D0,F1,58,60,A9,00,8D,12,91,20,BE,1B,AA,A0,00,A5,0D,D0,08
60740 DATA 20,D6,1B,20,CC,1B,58,60,86,22,38,A5,33,E5,22,85,33,A5,34,E9,00,85,34
60750 DATA 38,A5,33,E9,02,85,33,85,35,85,22,85,43,A5,34,E9,00,85,34,85,36,85,23
60760 DATA 85,44,C5,32,90,0A,D0,0B,A5,33,C5,31,90,02,D0,03,4C,35,C4,E0,00,F0,03
60770 DATA 20,CC,1B,98,18,65,22,85,22,90,02,E6,23,A0,00,A9,2C,91,22,85,08,A9,3A
60780 DATA 85,07,A9,98,85,11,A5,7A,A4,7B,85,4B,84,4C,A5,43,A4,44,85,7A,84,7B,20
60790 DATA 8D,D4,20,E2,D7,20,DA,C9,A5,4B,A4,4C,85,7A,84,7B,58,60,AD,1C,91,29,DF
60800 DATA 8D,1C,91,09,E0,8D,1C,91,60,20,B0,1B,AD,1D,91,29,10,F0,F9,AD,10,91,60
60810 DATA 20,BE,1B,91,22,C8,CA,D0,F7,60,A5,47,85,22,A5,48,85,23,60
60820 DATA *
60900 DATA 39936, 56263: REM                                            CBM64
60910 DATA A9,00,85,BD,4C,19,9C,A9,56,D0,02,A9,D6,85,BD,20,FD,AE,20,8B,B0,85,49
60920 DATA 84,4A,A9,00,8D,EC,07,AD,EC,07,29,00,8D,EC,07,AD,02,DD,09,04,8D,02,DD
60930 DATA 78,A9,7F,8D,0D,DD,AD,0D,DD,AD,00,DD,09,04,8D,00,DD,A5,BD,D0,18,8D,03
60940 DATA DD,20,B0,9D,A0,06,88,D0,FD,AD,0D,DD,29,10,F0,F1,AD,0D,DD,4C,85,9C,AD
60950 DATA 0D,DD,29,10,F0,02,D0,09,AD,0D,DD,29,10,F0,F0,D0,00,AD,00,DD,29,FB,8D
60960 DATA 00,DD,AE,0D,DD,09,04,8D,00,DD,A9,FF,8D,03,DD,4C,AF,9C,20,C1,9D,48,20
60970 DATA BE,9D,85,0D,20,BE,9D,85,0E,20,BE,9D,85,45,20,BE,9D,85,46,A9,00,85,0C
60980 DATA 20,E7,B0,85,49,84,4A,68,C9,56,D0,30,F0,6D,A5,BD,8D,01,DD,20,BE,9D,A5
60990 DATA 0D,8D,01,DD,20,BE,9D,A5,0E,8D,01,DD,20,BE,9D,A5,45,8D,01,DD,20,BE,9D
61000 DATA A5,46,8D,01,DD,20,B0,9D,A5,BD,C9,56,D0,3F,A9,FF,8D,03,DD,A5,0D,D0,09
61010 DATA A2,05,20,D6,9D,A0,00,F0,0F,A0,02,B1,47,85,23,88,B1,47,85,22,88,B1,47
61020 DATA AA,20,C1,9D,8E,01,DD,20,B0,9D,E0,00,F0,0F,20,C1,9D,B1,22,8D,01,DD,20
61030 DATA B0,9D,C8,CA,D0,F1,58,60,A9,00,8D,03,DD,20,BE,9D,AA,A0,00,A5,0D,D0,08
61040 DATA 20,D6,9D,20,CC,9D,58,60,86,22,38,A5,33,E5,22,85,33,A5,34,E9,00,85,34
61050 DATA 38,A5,33,E9,02,85,33,85,35,85,22,85,43,A5,34,E9,00,85,34,85,36,85,23
61060 DATA 85,44,C5,32,90,0A,D0,0B,A5,33,C5,31,90,02,D0,03,4C,35,A4,E0,00,F0,03
61070 DATA 20,CC,9D,98,18,65,22,85,22,90,02,E6,23,A0,00,A9,2C,91,22,85,08,A9,3A
61080 DATA 85,07,A9,98,85,11,A5,7A,A4,7B,85,4B,84,4C,A5,43,A4,44,85,7A,84,7B,20
61090 DATA 8D,B4,20,E2,B7,20,DA,A9,A5,4B,A4,4C,85,7A,84,7B,58,60,AD,00,DD,29,FB
61100 DATA 8D,00,DD,09,04,8D,00,DD,60,20,B0,9D,AD,0D,DD,29,10,F0,F9,AD,01,DD,60
61110 DATA 20,BE,9D,91,22,C8,CA,D0,F7,60,A5,47,85,22,A5,48,85,23,60
61120 DATA *
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commodore

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SuperScript does everything he wanted... and much more. It provides a complete document preparation and storage system, making optimum use of memory and disk space. In short, it provides all the advantages of a dedicated professional word processor... And now SUPERSCRIPT II is available for Commodore models 700 and 8096, with a host of new features including arithmetic, selective sort, column move... and the 700 series version even includes a spelling-checker!

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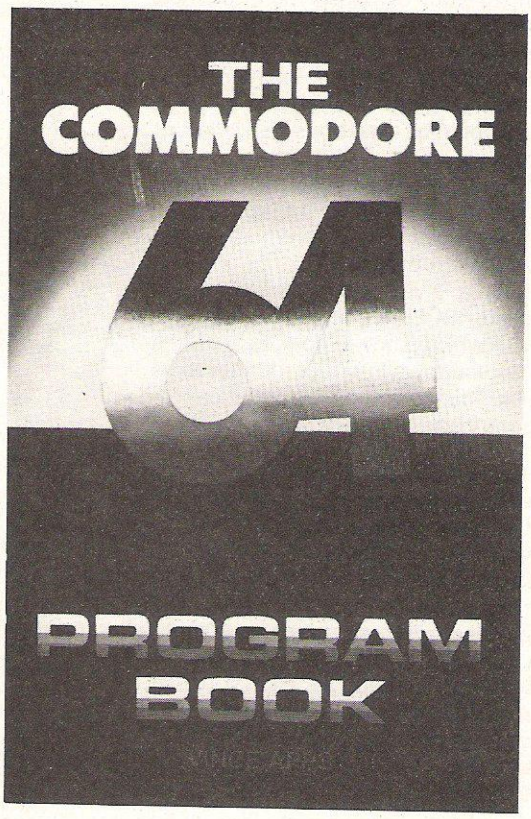

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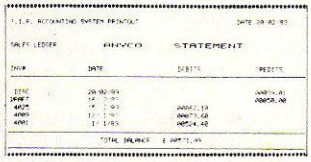

Features include:
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- Cash summary – debitors and creditors
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- PLUS many, many more features – all in ONE program.

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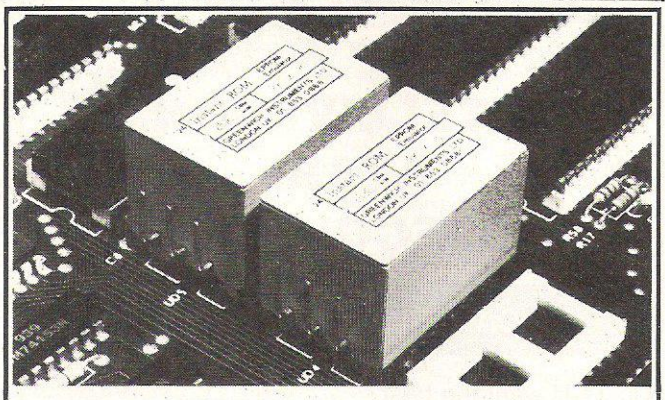

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Adaptor GA1 (essential for PET users) ..... £ 6.00

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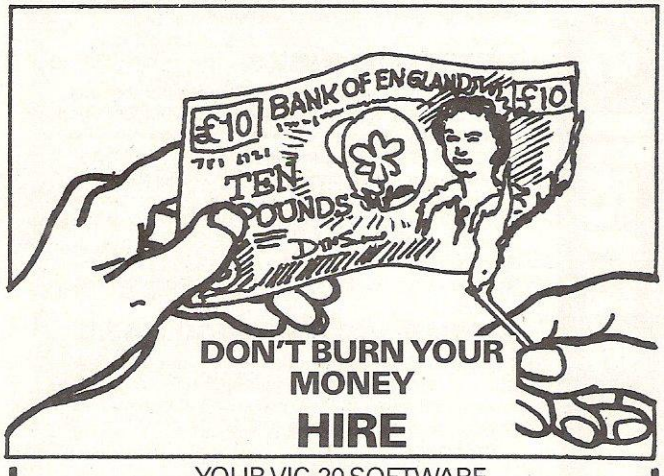

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Features of the 64

More useful ideas and information about the Commodore 64, including how to use the built in error messages of the 64 and interesting effects created by the SID chip. But first, how to use the interrupt generated by the Raster Compare register.

When writing machine code routines, you sometimes require an error message to be displayed if a check in your program creates one. Most of the Basic and Kernal routines will create their own messages if certain values are not to their liking. But you may want to test values and give error messages out of bounds. There are some routines that are there for displaying certain messages but not all.

Here we will list all of the error messages and how to send them. It must be noted that there is no error number zero. Any error message above $1E will be displayed as a weird character and any error number above $7F will be ignored. To display a certain error, the machine code is as follows:

```
LDX #number
JMP $A437
e.g. LDX #$14
     JMP $A437
```

Will display the message:
?DIVISION BY ZERO ERROR

The address given for each message is the address in memory where the start of the message appears.

MESSAGE	MESSAGE NUMBER	ADDRESS OF MESSAGE
TOO MANY FILES	$01	$A19E
FILE OPEN	$02	$A1AC
FILE NOT OPEN	$03	$A1B5
FILE NOT FOUND	$04	$A1C2
DEVICE NOT PRESENT	$05	$A1D0
NOT INPUT FILE	$06	$A1E2
NOT OUTPUT FILE	$07	$A1F0
MISSING FILE NAME	$08	$A1FF
ILLEGAL DEVICE NUMBER	$09	$A210
NEXT WITOUT FOR	$0A	$A225
SYNTAX	$0B	$A235
RETURN WITHOUT GOSUB	$0C	$A23B
OUT OF DATA	$0D	$A24F
ILLEGAL QUANTITY	$0E	$A25A
OVERFLOW	$0F	$A26A
OUT OF MEMORY	$10	$A272
UNDEF'D STATEMENT	$11	$A27F
BAD SUBSCRIPT	$12	$A290
REDIM'D ARRAY	$13	$A29D
DIVISION BY ZERO	$14	$A2AA
ILLEGAL DIRECT	$15	$A2BA
TYPE MISMATCH	$16	$A2C8
STRING TOO LONG	$17	$A2D5
FILE DATA	$18	$A2E4
FORMULA TOO COMPLEX	$19	$A2ED
CAN'T CONTINUE	$1A	$A300
UNDEF'D FUNCTION	$1B	$A30E
VERIFY	$1C	$A31E
LOAD	$1D	$A324
BREAK	$1E	$A383

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```
5 GOSUB11000
10 POKE53280,2:POKE56334,PEEK(56334)AND254
20 SYS49152:POKE49206,1
30 I=50:GOSUB100
40 A=PEEK(56320)
50 IF((AAND2)=0)ANDI<210THENI=I+2
60 IF((AAND1)=0)ANDI>50THENI=I-2
70 GOSUB100
80 IF(AAND16)=0THENPOKE56334,PEEK(56334)OR1:END
90 GOTO40
100 POKE49232,I:POKE49211,40+I:RETURN
10000 DATA120,169,34,141,20,3,169
10010 DATA192,141,21,3,173,17,208
10020 DATA41,127,141,17,208,169,151
10030 DATA141,18,208,173,26,208,9
10040 DATA1,141,26,208,88,96,169
10050 DATA1,44,25,208,208,3,76
10060 DATA49,234,173,33,208,41,15
10070 DATA201,2,208,21,169,1,141
10080 DATA33,208,169,90,141,18,208
10090 DATA169,1,141,25,208,104,168
10100 DATA104,170,104,64,169,2,141
10110 DATA33,208,169,50,141,18,208
10120 DATA76,63,192,-1
11000 I=49152
11010 READA:IFA=-1THEN11050
11020 POKEI,A:I=I+1
11030 T=T+A
11040 GOTO11010
11050 IF T<>9433 THEN PRINT"■DATA ERROR:"T,T:END
11060 IF I<>49239 THEN PRINT"■NUMBER OF DATA ERROR":END
11070 RETURN
READY.
```

Raster Interrupts.

A very useful part of the 64's VIC chip is the way that interrupts can be caused by the raster register. This can be very useful for producing 'Split Screens' as in The Hobbit.

The raster scans down the television screen and puts onto the screen the information sent to it by the computer. There are two registers that affect the raster. These are locations $D012 (53266) which is the low byte of the raster position, and $D011 (53265) which holds in its highest bit the high bit of the raster position. These locations can be read to get the current raster position.

The raster value goes between 0 and 320 (it is very hard to find the maximum value) but the only values that are actually on the screen are between 51 and 251 not including the border. This means that for most purposes the highest bit is never needed.

There is a use, however, for the highest bit: A lot of games boast the fact that they have flicker free sprites and graphics. The high bit can be WAITed for in Basic to produce flicker free displays. The method of doing so is to use the line following:

WAIT53265,128:WAIT53265,128,128

This first waits for the high bit to become 1 and then for the high bit to become zero. Just waiting for it to become 1 will not work and the wait will be about halfway down the first line on the screen. A short program to test the usefulness of the screen wait is as follows. If you want to see how it would look without the wait, insert REM at the beginning of line 20.

```
10 FORI=0TO15
20 WAIT53265,128:WAIT53265,128,128
30 POKE53281,I
40 NEXT
50 GOTO10
```

This program just changes the screen colour using the screen wait.

This is fine when you just wish to intercept the raster at the top of the screen but in some cases, it could be useful to stop it at other places on the screen. This is where the raster interrupt comes into being. The two registers mentioned earlier have a second purpose, that of setting a raster compare value. When this value has been set and bit 0 of location $D01A (53274) has been set to a 1, each time the raster value is the same as the raster compare value, an interrupt is forced and if you have a routine 'wedged' into interrupts to carry out this interrupt, it can be used. The way to test if it is a normal interrupt or a raster

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```
0000 1200       OSIRIS=$FF   ;It's the greatest
0001 1200 A9FF  LDA #OSIRIS  ;Buy immediately!
```

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one is done at SPLIT1 in the disassembly following. If it was not caused by the raster, a jump to the normal interrupts is done, but if it was caused by the raster, then our own routine is carried out.

When the change has been done, a 1 is written to the VIC interrupt register and return to normal operation.

In the routine, there are two parts depending on the present screen colour, one changes the colour of the background at the top of the screen and the other changes the colour at the halfway point on the screen. This is the easiest form of split screen use where the screen background colour is actually two colours, red at the top and purple at the bottom. This could easily be changed to, say, two different text screens, a text screen and a hi-res etc.

One last point to mention about the split screen routine is that with the standard keyboard scanning routine still working, the split is slightly untidy especially when a key is pressed.

The basic program included has the data for the machine code routine and a little program that allows you to change the top and bottom coordinates of the raster compare using the joystick. When running, the keyboard has been switched off so that the lines are neat and to exit the program, press stop restore or the fire button on the joystick. Experiment with the directions on the joystick for moving the split.

```
1000 *=$C000 ; START ADDRESS OF CODE
1010              SEI                   ; DISABLE IRQ
1020              LDA #<SPLIT1          ; NEW IRQ LO
1030              STA $0314
1040              LDA #>SPLIT1          ; NEW IRQ HI
1050              STA $0315
1060              LDA $D011             ; RASTER SCAN HI BIT
1070              AND #$7F
1080              STA $D011
1090              LDA #$97
1100              STA $D012             ; RASTER SCAN LO BYTE
1105              LDA $D01A
1110              ORA #$01
1140              STA $D01A             ; ENABLE RASTER IRQ
1150              CLI                   ; ENABLE IRQ
1160              RTS
1170 SPLIT1       LDA #$01              ; TEST IF RASTER
1180              BIT $D019             ;IRQ HAS OCCURED
1190              BNE CHANGE            ; IF NOT, JUMP
1200              JMP $EA31             ;TO NORMAL IRQ
1210 CHANGE       LDA $D021             ; CHECK IF SCREEN
1211              AND #$0F              ;COLOUR IS RED
1212              CMP #$02
1213              BNE CHANGE1           ; NO.
1219              LDA #$04              ; CHANGE SCREEN
1220              STA $D021             ;COLOUR TO PURPLE
1230              LDA #$00              ; SET RASTER COMPARISON
1235              STA $D012             ;TO TOP OF SCREEN
1240 EXIT         LDA #$01              ; TELL COMPUTER THAT
1250              STA $D019             ;RASTER IRQ HAS BEEN DONE
1300              PLA                   ; PULL REGISTERS AND RETURN
1301              TAY                   ;FROM INTERRUPTS
1302              PLA
1303              TAX
1304              PLA
1310              RTI
1380 CHANGE1      LDA #$02              ; SCREEN IS PURPLE CHANGE
1390              STA $D021             ;TO RED
1400              LDA #$37              ; SET RASTER COMPARE TO
1410              STA $D012             ;HALFWAY DOWN SCREEN
1420              JMP EXIT              ; EXIT IRQ
```

HINTS AND TIPS

This program shows how the sync and ring-mod bits in the SID chip control registers can be used to produce interesting sound effects. They are both done by setting a single tone into voice 3 and scanning up and down the scale for voice 1 with the ring-mod or sync set for voices 1 and 3.

```
10 S=54272
20 GOSUB63000
30 PRINT"□PRESS KEY FOR REQUIRED SOUND:"
40 PRINT"■■■■■■■■■■1: TARDIS (DEMO OF RING MOD)"
50 PRINT"■■■■■■■■■■2: DEMO OF SYNC"
65 PRINT"■■■■■■■■■■■■■■■■■■HIT ANY KEY TO CHOOSE ANOTHER"
70 GETA$:IFVAL(A$)<1ORVAL(A$)>2THEN70
90 ONVAL(A$)GOTO1000,2000
1000 POKES+24,15:POKES+5,0:POKES+6,240
1010 POKES+4,21
1020 POKES+15,19:POKES+14,136
1030 FORK=0TO65535STEP1500:GOSUB4000:NEXT
1040 FORK=65535TO0STEP-1500:GOSUB4000:NEXT
1050 GOTO1030
2000 POKES+24,15:POKES+5,0:POKES+6,240
2010 POKES+4,35
2020 POKES+15,19:POKES+14,136
2030 FORK=0TO65535STEP600:GOSUB4000:NEXT
2040 FORK=65535TO0STEP-600:GOSUB4000:NEXT
2050 GOTO2030
4000 POKES+1,INT(K/256):POKES,K-INT(K/256)*256
4010 GETA$:IFA$<>""THENRUN
4020 RETURN
63000 FORI=0TO24
63010 POKES+I,0:NEXT:RETURN
READY.
```


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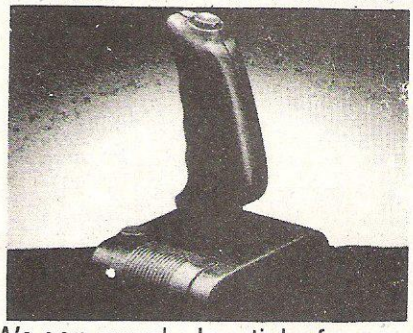

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Speedier utilities

This month we have a program to display track and sector on disk. The slow routines have been written in Machine Code to speed up the process.

The utility disk supplied with Commodore disk units contains a program that displays, in hexadecimal form, the contents of specified sectors on disk. Unfortunately, as the program is written entirely in Basic, you feel you have enough time to eat a three-course meal in the time it takes to display a full screenful of information! The parts that take up all of this time are the read from disk and conversion of decimal numbers, held in an array, to hex and ASCII characters.

By rewriting these slower sections in machine code, I have produced a version that can display to the screen almost instantly and output to a printer as fast as the print head can print. There are two main parts to the machine code; the first reads the specified block into memory just above Basic, and the second (this has two entry points, one for the first 128 bytes displayed and the other for the second 128) displays it to either the screen or printer.

As the program needs 256 bytes of memory that is safe from Basic (for the block), the End of Basic pointer has been lowered so that only around 6K is available to Basic. I have set it this low to maintain compatibility between 8, 16 and 32K machines – so you will have to reset the computer after you have finished using the program (or alter locations 52/3 back to their original values).

Both Basic 2.0 and Basic 4.0 are catered for without changes (a check is made at lines 210-240), and disk units 3040, 4040 and 2031 can be used. A small change to line 470 should allow the use of the 8050 and 8250 drives. (I say 'should' as I have no way of testing this out!) Alter T>35 to T>77 for the 8050 and to T>154 for the 8250.

This change should allow access to the extra tracks that are available on these units. There is no check in the program for the amount of sectors the user enters as these vary between the different machines; any errors will be taken care of by the disk operating system which will halt the program with error 66 (ILLEGAL TRACK OR SECTOR).

If you are using a 2031 single drive then enter 'S' when prompted for the drive number as this will tell the program to set up the address for the disk buffer in the correct place for this unit – all dual drives use address $1100 while the 2031 (and the 1541) uses $0300.

To exit the program type 'x' (+ return) when asked to enter the next track number. Typing 'x' in response to 'SECTOR' will take you back one step to 'TRACK'. Also, the space bar may be used instead of 'Y' (for 'yes') when asked if you want to continue to the next track and sector displayed. The 'bomb proof input' subroutine at line 810 prevents dropping back to Basic on the PET/CBM (or accidently continuing, without having entered anything, to the next statement on the CBM-64).

The program has been liberally sprinkled with REMs to help users understand how it works. The "I" part in line 400 is only really needed for the older 3040 drive as all the later ones automatically initialise themselves as soon as a disk is inserted; but don't miss out the OPEN15,8,15 as it is needed for all drives.

The second listing shows the modifications needed to enable the program to run on the CBM-64. The changes are mainly the removal of drive number references, not needed for the single drive 1541; and the relocation of the machine code section. The PET/CBM version has the machine code in the first cassette buffer while the 64 version has it above Basic.

Also an extra routine is added to make up for the lack of a hexadecimal number output routine; this is part of the m/c monitor in the PET/CBM and totally missing in the 64. This version should also run on the Vic providing it has got the full 29K expansion, but the screen display will be rather ragged due to its 22 columns.

```
M/C DISPLAY T & S
100 REM ** DISPLAY T & S (MACHINE CODE VERSION)  -  D. VINER - JAN 1984 **
110 REM ** FOR USE ON BASIC 2/4 PET/CBM (8-32K)  PLUS 3040/4040/2031 DRIVES **
120 :
130 REM * ADJUST MEMORY POINTER *
140 POKE52,0:POKE53,30:POKE59468,12:PRINTCHR$(142):CLR
150 :
160 REM * SET UP MACHINE CODE *
170 A=640
180 READB:IFB=999THEN220
190 POKEA,B:A=A+1:GOTO180
200 :
210 REM * CHECK FOR BASIC 2 OR 4 *
220 IFPEEK(65534)=27ANDPEEK(65535)=230THENPOKE767,117:POKE768,231:GOTO270
230 IFPEEK(65534)=66ANDPEEK(65535)=228THENPOKE767,34:POKE768,215:GOTO270
240 PRINT"[illegible] ROM TYPE NOT RECOGNISED ":STOP
250 :
260 REM * SCREEN DISPLAY *
```

```
 270 PRINT"■■■
```

```
FOR THE COMMODORE-64 REMOVE LINES 210-240 AND 290-320

AND REPLACE ALL THE FOLLOWING :-

110 REM ** FOR USE ON CBM-64  &  1541 DISK DRIVE                                **
140 POKE55,0:POKE56,112:PRINTCHR$(142):CLR
170 A=28672
180 READB:IFB=999THEN270
400 OPEN15,8,15:GOSUB770:REM * OPEN ERROR CHANNEL *
440 POKE198,0:PRINT"■TRACK : ";:GOSUB810:T=VAL(X$)
470 IFT=0ORT>35ORX$="X"THENCLOSE2:CLOSE4:CLOSE15:PRINT"□":END
540 PRINT#15,"U1:2,";0;T;S:GOSUB770:REM * READ BLOCK FROM DISK TO BUFFER *
560 PRINT#15,"M-R"CHR$(0)CHR$(3)
580 POKE30720,ASC(A$):SYS28672:REM * READ REST OF BLOCK INTO MEMORY *
610 CMD4:SYS28691:REM * DISPLAY FIRST HALF OF BLOCK *
640 SYS28699:PRINT#4:REM * DISPLAY REST OF BLOCK *
670 T1=PEEK(30720):S1=PEEK(30721)
830 REM * MACHINE CODE DATA *
840 DATA162,2,32,198,255,160,1,32,207,255,153,0,120,200,208,247
850 DATA76,204,255,169,120,133,181,169,0,133,180,165,180,32,126,112
860 DATA169,32,32,210,255,169,58,32,210,255,169,32,32,210,255,160
870 DATA0,177,180,32,126,112,169,32,32,210,255,200,192,8,208,241
880 DATA160,0,169,58,32,210,255,169,32,32,210,255,177,180,201,32
890 DATA144,12,201,96,144,10,201,160,144,4,201,224,144,2,169,32
900 DATA32,210,255,200,192,8,208,228,169,13,32,210,255,24,165,180
910 DATA105,8,133,180,201,0,208,1,96,201,128,208,158,96,72,74
920 DATA74,74,74,32,150,112,170,104,41,15,32,150,112,72,138,32
930 DATA210,255,104,76,210,255,24,105,246,144,2,105,6,105,58,96,999
READY.
```

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64 Memory Map

Due to popular demand we are publishing the memory map for the 64. This will come in two parts. The first part, which follows, is a description of the memory location below Basic programming memory. Next month we will publish the explanation of the ROM routines.

0000		0	Chip directional register
0001		1	Chip I/O; memory & tape control
0003	-0004	3-4	Float-Fixed vector
0005	-0006	5-6	Fixed-Float vector
0007		7	Search character
0008		8	Scan-quotes flag
0009		9	TAB column save
000A		10	0 = LOAD, 1 = VERIFY
000B		11	Input buffer pointer/# subscrpt
000C		12	Default DIM flag
000D		13	Type: FF = string, 00 = numeric
000E		14	Type: 80 = integer, 00 = floating point
000F		15	DATA scan/LIST quote/memry flag
0010		16	Subscript/FNx flag
0011		17	0 = INPUT;$40 = GET;$98 = READ
0012		18	ATN sign/Comparison eval flag
0013		19	Current I/O prompt flag
0014	-0015	20-21	Integer value
0016		22	Pointer: temporary string stack
0017	-0018	23-24	Last temp string vector
0019	-0021	25-33	Stack for temporary strings
0022	-0025	34-37	Utility pointer area
0026	-002A	38-42	Product area for multiplication
002B	-002C	43-44	Pointer: Start-of-Basic
002D	-002E	45-46	Pointer: Start-of-Variables
002F	-0030	47-48	Pointer: Start-of-Arrays
0031	-0032	49-50	Pointer: End-of-Arrays
0033	-0034	51-52	Pointer: String-storage(moving down)
0035	-0036	53-54	Utility string pointer
0037	-0038	55-56	Pointer: Limit-of-memory
0039	-003A	57-58	Current Basic line number
003B	-003C	59-60	Previous Basic line number
003D	-003E	61-62	Pointer: Basic statement for CONT
003F	-0040	63-64	Current DATA line number
0041	-0042	65-66	Current DATA address
0043	-0044	67-68	Input vector
0045	-0046	69-70	Current variable name
0047	-0048	71-72	Current variable address
0049	-004A	73-74	Variable pointer for FOR/NEXT
004B	-004C	75-76	Y-save; op-save; Basic pointer save
004D		77	Comparison symbol accumulator
004E	-0053	78-83	Misc work area, pointers, etc
0054	-0056	84-86	Jump vector for functions
0057	-0060	87-96	Misc numeric work area
0061		97	Accum#1: Exponent
0062	-0065	98-101	Accum#1: Mantissa
0066		102	Accum#1: Sign
0067		103	Series evaluation constant pointer
0068		104	Accum#1 hi-order (overflow)
0069	-006E	105-110	Accum#2: Exponent, etc.
006F		111	Sign comparison, Acc#1 vs #2
0070		112	Accum#1 lo-order (rounding)
0071	-0072	113-114	Cassette buff len/Series pointer
0073	-008A	115-138	CHRGET subroutine; get Basic char
007A	-007B	122-123	Basic pointer (within subrtn)
008B	-008F	139-143	RND seed value
0090		144	Status word ST
0091		145	Keyswitch PIA: STOP and RVS flags
0092		146	Timing constant for tape
0093		147	Load = 0, Verify = 1
0094		148	Serial output: deferred char flag
0095		149	Serial deferred character
0096		150	Tape EOT received
0097		151	Register save
0098		152	How many open files
0099		153	Input device, normally 0
009A		154	Output CMD device, normally 3
009B		155	Tape character parity
009C		156	Byte-received flag
009D		157	Direct = $80/RUN = 0 output control
009E		158	Tp Pass 1 error log/char buffer
009F		159	Tp Pass 2 err log corrected
00A0	-00A2	160-162	Jiffy Clock HML
00A3		163	Serial bit count/EOI flag
00A4		164	Cycle count
00A5		165	Countdown,tape write/bit count
00A6		166	Tape buffer pointer
00A7		167	Tp Wrt ldr count/Rd pass/inbit
00A8		168	Tp Wrt new byte/Rd error/inbit cnt
00A9		169	Wrt start bit/Rd bit err/stbit
00AA		170	Tp Scan;Cnt;Ld;End/byte assy
00AB		171	Wr lead length/Rd checksum/parity
00AC	-00AD	172-173	Pointer: tape bufr, scrolling
00AE	-00AF	174-175	Tape end adds/End of program
00B0	-00B1	176-177	Tape timing constants
00B2	-00B3	178-179	Pntr: start of tape buffer
00B4		180	1 = Tp timer enabled; bit count
00B5		181	Tp EOT/RS232 next bit to send
00B6		182	Read character error/outbyte buf
00B7		183	# characters in file name
00B8		184	Current logical file
00B9		185	Current secndy address
00BA		186	Current device
00BB	-00BC	187-188	Pointer to file name

00BD		189	Wr shift word/Rd input char
00BE		190	# blocks remaining to Wr/Rd
00BF		191	Serial word buffer
00C0		192	Tape motor interlock
00C1	-00C2	193-194	I/O start address
00C3	-00C4	195-196	Kernel setup pointer
00C5		197	Last key pressed
00C6		198	# chars in keybd buffer
00C7		199	Screen reverse flag
00C8		200	End-of-line for input pointer
00C9	-00CA	201-202	Input cursor log (row, column)
00CB		203	Which key: 64 if no key
00CC		204	0 = flash cursor
00CD		205	Cursor timing countdown
00CE		206	Character under cursor
00CF		207	Cursor in blink phase
00D0		208	Input from screen/from keyboard
00D1	-00D2	209-210	Pointer to screen line
00D3		211	Position of cursor on above line
00D4		212	0 = direct cursor, else programmed
00D5		213	Current screen line length
00D6		214	Row where curosr lives
00D7		215	Last inkey/checksum/buffer
00D8		216	# of INSERTs outstanding
00D9	-00F2	217-242	Screen line link table
00F3	-00F4	243-244	Screen color pointer
00F5	-00F6	245-246	Keyboard pointer
00F7	-00F8	247-248	RS-232 Rcv pntr
00F9	-00FA	249-250	RS-232 Tx pntr
00FF	-010A	256-266	Floating to ASCII work area
0100	-013E	256-318	Tape error log
0100	-01FF	256-511	Processor stack area
0200	-0258	512-600	Basic input buffer
0259	-0262	601-610	Logical file table
0263	-026C	611-620	Device # table
026D	-0276	621-630	Sec Adds table
0277	-0280	631-640	Keybd buffer
0281	-0282	641-642	Start of Basic Memory
0283	-0284	643-644	Top of Basic Memory
0285		645	Serial bus timeout flag
0286		646	Current color code
0287		647	Color under cursor
0288		648	Screen memory page
0289		649	Max size of keybd buffer
028A		650	Repeat all keys
028B		651	Repeat speed counter
028C		652	Repeat delay counter
028D		653	Keyboard Shift/Control flag
028E		654	Last shift pattern
028F	-0290	655-656	Keyboard table setup pointer
0291		657	Keyboard shift mode
0292		658	0 = scroll enable
0293		659	RS-232 control reg
0294		660	RS-232 command reg
0295	-0296	661-662	Bit timing
0297		663	RS-232 status
0298		664	# bits to send
0299	-029A	665	RS-232 speed/code
029B		667	RS232 receive pointer
029C		668	RS232 input pointer
029D		669	RS232 transmit pointer
029E		670	RS232 output pointer
029F	-02A0	671-672	IRQ save during tape I/O
02A1		673	CIA 2 (NMI) Interrupt Control
02A2		674	CIA 1 Timer A control log
02A3		675	CIA 1 Interrupt Log
02A4		676	CIA 1 Timer A enabled flag
02A5		677	Screen row marker
02C0	-02FE	704-766	(Sprite 11)
0300	-0301	768-769	Error message link
0302	-0303	770-771	Basic warm start link
0304	-0305	772-773	Crunch Basic tokens link
0306	-0307	774-775	Print tokens link
0308	-0309	776-777	Start new Basic code link
030A	-030B	778-779	Get arithmetic element link
030C		780	SYS A-reg save
030D		781	SYS X-reg save
030E		782	SYS Y-reg save
030F		783	SYS status reg save
0310	-0312	784-785	USR function jump (B248)
0314	-0315	788-789	Hardware interrupt vector (EA31)
0316	-0317	790-791	Break interrupt vector (FE66)
0318	-0319	792-793	NMI interrupt vector (FE47)
031A	-031B	794-795	OPEN vector (F34A)
031C	-031D	796-797	CLOSE vector (F291)
031E	-031F	798-799	Set-input vector (F20E)
0320	-0321	800-801	Set-output vector (F250)
0322	-0323	802-803	Restore I/O vector (F333)
0324	-0325	804-805	INPUT vector (F157)
0326	-0327	806-807	Output vector (F1CA)
0328	-0329	808-809	Test-STOP vector (F6ED)
032A	-032B	810-811	GET vector (F13E)
032C	-032D	812-813	Abort I/O vector (F32F)
032E	-032F	814-815	Warm start vector (FE66)
0330	-0331	816-817	LOAD link (F4A5)
0332	-0333	818-819	SAVE link (F5ED)
033C	-03FB	828-1019	Cassette buffer
0340	-037E	832-894	(Sprite 13)
0380	-03BE	896-958	(Sprite 14)
03C0	-03FE	960-1022	(Sprite 15)
0400	-07FF	1024-2047	Screen memory
0800	-9FFF	2048-40959	Basic RAM memory
8000	-9FFF	32768-40959	Alternate: ROM plug-in area
A000	-BFFF	40960-49151	ROM: Basic
A000	-BFFF	49060-59151	Alternate: RAM
C000	-CFFF	49152-53247	RAM memory, including alternate
D000	-D02E	53248-53294	Video Chip (6566)
D400	-D41C	54272-54300	Sound Chip (6581 SID)
D800	-DBFF	55296-56319	Color nybble memory
DC00	-DC0F	56320-56335	Interface chip 1, IRQ (6526 CIA)
DD00	-DD0F	56576-56591	Interface chip 2, NMI (6526 CIA)
D000	-DFFF	53248-53294	Alternate: Character set
E000	-FFFF	57344-65535	ROM: Operating System
E000	-FFFF	57344-65535	Alternate: RAM
FF81	-FFF5	65409-65525	Jump Table, Including:
	FFC6		- Set Input channel
	FFC9		- Set Output channel
	FFCC		- Restore default I/O channels
	FFCF		- INPUT
	FFD2		- PRINT
	FFE1		- Test Stop key
	FFE4		- GET

MACHINE CODE

64 Basic aids x 4

In the February issue of Commodore Computing International, we mentioned that we would be running a series of routines for the 64 that can be used as programming aids. There are four routines this month: Trace, Find, Disk, Catalog. None of these routines' addresses conflicts with each other or with those previously published. The disk and catalog routines assume that the disk unit is unit 8.

Trace:

This routine enables a Basic program line trace facility which prints the Basic line number being run at the current cursor position. Trace is enabled by SYS49409 and disabled by SYS49479.

```
10 I=49409:T=0
20 READA:IFA=-1THEN50
30 POKEI,A:I=I+1
40 T=T+A:GOTO20
50 IFT<>10002THENPRINT"■■CHECKSUM ERROR:"10002,T:
60 PRINT"■■USE SYS49409 TO ENABLE TRACE"
70 PRINT"■■USE SYS49479 TO DISABLE"
80 PRINT"■■":END
100 DATA120,169,14,141,8,3,169
110 DATA193,141,9,3,88,96,165
120 DATA157,240,3,76,228,167,165
130 DATA57,201,0,208,9,165,58
140 DATA201,0,208,3,76,228,167
150 DATA165,57,141,24,193,165,58
160 DATA141,30,193,169,91,32,210
170 DATA255,166,57,165,58,32,205
180 DATA189,169,93,32,210,255,169
190 DATA32,32,210,255,76,228,167
200 DATA120,169,228,141,8,3,169
210 DATA167,141,9,3,88,96,-1
```

```
 0  C101  78       SEI
 1  C102  A90E     LDA  #$0E
 2  C104  8D0803   STA  $0308
 3  C107  A9C1     LDA  #$C1
 4  C109  8D0903   STA  $0309
 5  C10C  58       CLI
 6  C10D  60       RTS
 7  C10E  A59D     LDA  $9D
 8  C110  F003     BEQ  $C115
 9  C112  4CE4A7   JMP  $A7E4
10  C115  A539     LDA  $39
11  C117  C900     CMP  #$00
12  C119  D009     BNE  $C124
13  C11B  A53A     LDA  $3A
14  C11D  C900     CMP  #$00
15  C11F  D003     BNE  $C124
16  C121  4CE4A7   JMP  $A7E4
17  C124  A539     LDA  $39
18  C126  8D18C1   STA  $C118
19  C129  A53A     LDA  $3A
20  C12B  8D1EC1   STA  $C11E
21  C12E  A95B     LDA  #$5B
22  C130  20D2FF   JSR  $FFD2
23  C133  A639     LDX  $39
24  C135  A53A     LDA  $3A
25  C137  20CDBD   JSR  $BDCD
26  C13A  A95D     LDA  #$5D
27  C13C  20D2FF   JSR  $FFD2
28  C13F  A920     LDA  #$20
29  C141  20D2FF   JSR  $FFD2
30  C144  4CE4A7   JMP  $A7E4
31  C147  78       SEI
32  C148  A9E4     LDA  #$E4
33  C14A  8D0803   STA  $0308
34  C14D  A9A7     LDA  #$A7
35  C14F  8D0903   STA  $0309
36  C152  58       CLI
37  C153  60       RTS
```

```
10 I=49772:T=0
20 READA:IFA=-1THEN50
30 POKEI,A:I=I+1
40 T=T+A:GOTO20
50 IFT<>22816THENPRINT"■■CHECKSUM ERROR:"22816,T:END
60 PRINT"■■USE SYS49772 TO READ DISK ERROR"
70 PRINT"■■USE SYS49772"CHR$(34)"X"CHR$(34)" TO SEND DISK COMMAND"
80 PRINT"■":END
100 DATA32,121,0,240,3,76,226
110 DATA194,169,0,133,183,32,176
120 DATA194,169,13,32,210,255,169
130 DATA18,32,210,255,162,15,32
140 DATA198,255,32,207,255,72,165
150 DATA144,208,7,104,32,210,255
160 DATA76,138,194,104,169,15,133
170 DATA73,32,204,225,169,146,32
180 DATA210,255,169,13,32,210,255
190 DATA169,0,76,198,255,32,201
200 DATA194,141,155,194,141,234,194
210 DATA141,134,194,133,184,169,15
220 DATA133,185,169,8,133,186,76
230 DATA193,225,169,15,166,152,224
240 DATA0,240,16,221,88,2,208
250 DATA6,56,233,1,76,203,194
260 DATA202,240,2,208,240,96,201
270 DATA34,240,3,76,8,175,169
280 DATA15,133,73,32,204,225,32
290 DATA115,0,165,122,133,187,165
300 DATA123,133,188,162,0,32,99
310 DATA194,240,11,201,34,240,7
320 DATA232,32,93,194,76,0,195
330 DATA134,183,32,176,194,169,13
340 DATA32,210,255,76,116,164,-1
```

Disk:

This routine is the major part of a dos (disk operating system) aid, it allows the user to send dos commands without the OPEN 1,8,15 on the beginning.
An example of this is:
SYS49772"I" will replace:
OPEN15,8,15,"I"

It is obvious that there is not a lot of saving of typing but when the complete Basic aid is published, the sys calls will be given Basic command names e.g. SYS49772 will be replaced with DISK.

The other use of this sys call is to return a disk error message. By just typing SYS49772 the disk error channel will be read and displayed in reverse on the screen. Again when the completed basic aid is published, just DISK.

```
 0  C26C  207900    JSR  $0079     21  C29C  8549      STA  $49
 1  C26F  F003      BEQ  $C274     22  C29E  20CCE1    JSR  $E1CC
 2  C271  4CE2C2    JMP  $C2E2     23  C2A1  A992      LDA  #$92
 3  C274  A900      LDA  #$00      24  C2A3  20D2FF    JSR  $FFD2
 4  C276  85B7      STA  $B7       25  C2A6  A90D      LDA  #$0D
 5  C278  20B0C2    JSR  $C2B0     26  C2A8  20D2FF    JSR  $FFD2
 6  C27B  A90D      LDA  #$0D      27  C2AB  A900      LDA  #$00
 7  C27D  20D2FF    JSR  $FFD2     28  C2AD  4CC6FF    JMP  $FFC6
 8  C280  A912      LDA  #$12      29  C2B0  20C9C2    JSR  $C2C9
 9  C282  20D2FF    JSR  $FFD2     30  C2B3  8D9BC2    STA  $C29B
10  C285  A20F      LDX  #$0F      31  C2B6  8DEAC2    STA  $C2EA
11  C287  20C6FF    JSR  $FFC6     32  C2B9  8D86C2    STA  $C286
12  C28A  20CFFF    JSR  $FFCF     33  C2BC  85B8      STA  $B8
13  C28D  48        PHA            34  C2BE  A90F      LDA  #$0F
14  C28E  A590      LDA  $90       35  C2C0  85B9      STA  $B9
15  C290  D007      BNE  $C299     36  C2C2  A908      LDA  #$08
16  C292  68        PLA            37  C2C4  85BA      STA  $BA
17  C293  20D2FF    JSR  $FFD2     38  C2C6  4CC1E1    JMP  $E1C1
18  C296  4C8AC2    JMP  $C28A     39  C2C9  A90F      LDA  #$0F
19  C299  68        PLA            40  C2CB  A698      LDX  $98
20  C29A  A90F      LDA  #$0F      41  C2CD  E000      CPX  #$00
```

MACHINE CODE

```
42  C2CF  F010      BEQ  $C2E1      59  C2F3  A57A      LDA  $7A
43  C2D1  DD5802    CMP  $0258,X    60  C2F5  85BB      STA  $BB
44  C2D4  D006      BNE  $C2DC      61  C2F7  A57B      LDA  $7B
45  C2D6  38        SEC             62  C2F9  85BC      STA  $BC
46  C2D7  E901      SBC  #$01       63  C2FB  A200      LDX  #$00
47  C2D9  4CCBC2    JMP  $C2CB      64  C2FD  2063C2    JSR  $C263
48  C2DC  CA        DEX             65  C300  F00B      BEQ  $C30D
49  C2DD  F002      BEQ  $C2E1      66  C302  C922      CMP  #$22
50  C2DF  D0F0      BNE  $C2D1      67  C304  F007      BEQ  $C30D
51  C2E1  60        RTS             68  C306  E8        INX
52  C2E2  C922      CMP  #$22       69  C307  205DC2    JSR  $C25D
53  C2E4  F003      BEQ  $C2E9      70  C30A  4C00C3    JMP  $C300
54  C2E6  4C08AF    JMP  $AF08      71  C30D  86B7      STX  $B7
55  C2E9  A90F      LDA  #$0F       72  C30F  20B0C2    JSR  $C2B0
56  C2EB  8549      STA  $49        73  C312  A90D      LDA  #$0D
57  C2ED  20CCE1    JSR  $E1CC      74  C314  20D2FF    JSR  $FFD2
58  C2F0  207300    JSR  $0073      75  C317  4C74A4    JMP  $A474
```

```
10 I=49946:T=0
20 READA:IFA=-1THEN50
30 POKEI,A:I=I+1
40 T=T+A:GOTO20
50 IFT<>29730THENPRINT"■■CHECKSUM ERROR:"29730,T:END
60 PRINT"■■USE SYS49946,0 FOR DIRECTORY LISTING"
70 PRINT" OF DRIVE 0 AND SYS49946,1 FOR DRIVE 1"
80 PRINT"■■":END
100 DATA32,253,174,32,121,0,240
110 DATA11,201,48,240,7,201,49
120 DATA240,7,76,8,175,169,48
130 DATA208,2,169,49,141,235,195
140 DATA169,2,162,234,160,195,32
150 DATA189,255,169,14,32,203,194
160 DATA162,8,160,0,32,186,255
170 DATA32,192,255,144,10,72,165
180 DATA184,32,195,255,104,76,249
190 DATA224,160,3,132,183,166,184
200 DATA32,198,255,32,207,255,133
210 DATA87,32,183,255,208,114,32
220 DATA207,255,133,88,32,183,255
230 DATA208,104,164,183,136,208,224
240 DATA132,183,32,207,255,72,32
250 DATA183,255,170,104,224,0,208
260 DATA84,164,183,192,80,176,78
270 DATA153,0,2,170,240,4,230
280 DATA183,208,227,32,204,255,166
290 DATA159,224,3,240,5,166,158
300 DATA32,201,255,166,87,165,88
310 DATA32,205,189,169,32,32,210
320 DATA255,160,0,185,0,2,240
330 DATA6,32,210,255,200,208,245
340 DATA169,13,32,210,255,32,204
```

Catalog:

The last routine this month is a routine that displays the directory of a disk to the screen. The advantage of this routine over LOAD"$",8 is that the load loads the directory into memory and then you must list it. This routine will display the directory straight to the screen and not load over your program.

To display a directory, enter SYS49946,0 for drive 0 and all single disk owners and for the lucky ones who have double disk drives connected to their 64's, SYS49946,1 will display the directory on drive 1.

MACHINE CODE

```
350 DATA255,32,225,255,240,16,32
360 DATA228,255,201,32,208,5,32
370 DATA228,255,240,251,160,2,208
380 DATA155,32,204,255,165,184,32
390 DATA195,255,76,123,227,36,48,-1
```

```
 0  C31A  20FDAE    JSR  $AEFD
 1  C31D  207900    JSR  $0079
 2  C320  F00B      BEQ  $C32D
 3  C322  C930      CMP  #$30
 4  C324  F007      BEQ  $C32D
 5  C326  C931      CMP  #$31
 6  C328  F007      BEQ  $C331
 7  C32A  4C08AF    JMP  $AF08
 8  C32D  A930      LDA  #$30
 9  C32F  D002      BNE  $C333
10  C331  A931      LDA  #$31
11  C333  8DEBC3    STA  $C3EB
12  C336  A902      LDA  #$02
13  C338  A2EA      LDX  #$EA
14  C33A  A0C3      LDY  #$C3
15  C33C  20BDFF    JSR  $FFBD
16  C33F  A90E      LDA  #$0E
17  C341  20CBC2    JSR  $C2CB
18  C344  A208      LDX  #$08
19  C346  A000      LDY  #$00
20  C348  20BAFF    JSR  $FFBA
21  C34B  20C0FF    JSR  $FFC0
22  C34E  900A      BCC  $C35A
23  C350  48        PHA
24  C351  A5B8      LDA  $B8
25  C353  20C3FF    JSR  $FFC3
26  C356  68        PLA
27  C357  4CF9E0    JMP  $E0F9
28  C35A  A003      LDY  #$03
29  C35C  84B7      STY  $B7
30  C35E  A6B8      LDX  $B8
31  C360  20C6FF    JSR  $FFC6
32  C363  20CFFF    JSR  $FFCF
33  C366  8557      STA  $57
34  C368  20B7FF    JSR  $FFB7
35  C36B  D072      BNE  $C3DF
36  C36D  20CFFF    JSR  $FFCF
37  C370  8558      STA  $58
38  C372  20B7FF    JSR  $FFB7
39  C375  D068      BNE  $C3DF
40  C377  A4B7      LDY  $B7
41  C379  88        DEY
42  C37A  D0E0      BNE  $C35C
43  C37C  84B7      STY  $B7
44  C37E  20CFFF    JSR  $FFCF
45  C381  48        PHA
46  C382  20B7FF    JSR  $FFB7
47  C385  AA        TAX
48  C386  68        PLA
49  C387  E000      CPX  #$00
50  C389  D054      BNE  $C3DF
51  C38B  A4B7      LDY  $B7
52  C38D  C050      CPY  #$50
53  C38F  B04E      BCS  $C3DF
54  C391  990002    STA  $0200,Y
55  C394  AA        TAX
56  C395  F004      BEQ  $C39B
57  C397  E6B7      INC  $B7
58  C399  D0E3      BNE  $C37E
59  C39B  20CCFF    JSR  $FFCC
60  C39E  A69F      LDX  $9F
61  C3A0  E003      CPX  #$03
62  C3A2  F005      BEQ  $C3A9
63  C3A4  A69E      LDX  $9E
64  C3A6  20C9FF    JSR  $FFC9
65  C3A9  A657      LDX  $57
66  C3AB  A558      LDA  $58
67  C3AD  20CDBD    JSR  $BDCD
68  C3B0  A920      LDA  #$20
69  C3B2  20D2FF    JSR  $FFD2
70  C3B5  A000      LDY  #$00
71  C3B7  B90002    LDA  $0200,Y
72  C3BA  F006      BEQ  $C3C2
73  C3BC  20D2FF    JSR  $FFD2
74  C3BF  C8        INY
75  C3C0  D0F5      BNE  $C3B7
76  C3C2  A90D      LDA  #$0D
77  C3C4  20D2FF    JSR  $FFD2
78  C3C7  20CCFF    JSR  $FFCC
79  C3CA  20E1FF    JSR  $FFE1
80  C3CD  F010      BEQ  $C3DF
81  C3CF  20E4FF    JSR  $FFE4
82  C3D2  C920      CMP  #$20
83  C3D4  D005      BNE  $C3DB
84  C3D6  20E4FF    JSR  $FFE4
85  C3D9  F0FB      BEQ  $C3D6
86  C3DB  A002      LDY  #$02
87  C3DD  D09B      BNE  $C37A
88  C3DF  20CCFF    JSR  $FFCC
89  C3E2  A5B8      LDA  $B8
90  C3E4  20C3FF    JSR  $FFC3
91  C3E7  4C7BE3    JMP  $E37B
92  C3EA  2430      BIT  $30
```

VIZASTAR 64

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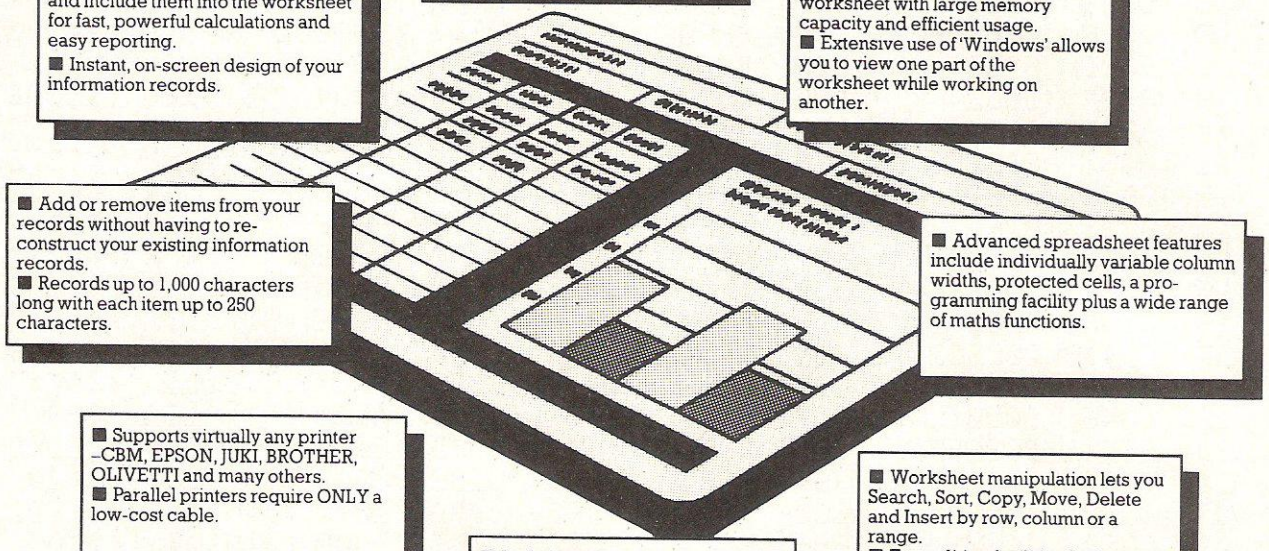

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```
10 I=49492:T=0
20 READA:IFA=-1THEN50
30 POKEI,A:I=I+1
40 T=T+A:GOTO20
50 IFT<>32027THENPRINT"■■CHECKSUM ERROR:"32027,T:END
60 PRINT"■■USE SYS49492,/STRING/ TO FIND STRING"
70 PRINT"■■":END
100 DATA32,253,174,32,99,194,133
110 DATA89,162,0,32,127,193,32
120 DATA157,193,120,169,23,141,0
130 DATA3,169,194,141,1,3,88
140 DATA32,171,193,32,24,194,32
150 DATA177,193,76,115,193,76,8
160 DATA175,32,93,194,240,248,197
170 DATA89,240,13,157,128,191,232
180 DATA224,64,208,239,162,23,76
190 DATA55,164,169,0,157,128,191
200 DATA134,34,96,165,43,24,105
210 DATA2,133,87,165,44,105,0
220 DATA133,88,96,162,0,160,2
230 DATA132,35,165,1,41,254,133
240 DATA1,177,87,221,128,191,8
250 DATA165,1,9,1,133,1,40
260 DATA208,7,200,232,228,34,208
270 DATA229,96,230,35,164,35,162
280 DATA0,177,87,240,3,76,177
290 DATA193,165,87,56,233,2,133
300 DATA87,165,88,233,0,133,88
310 DATA160,0,177,87,133,89,200
320 DATA177,87,133,88,5,89,240
330 DATA16,165,89,24,105,2,133
340 DATA87,165,88,105,0,133,88
350 DATA76,171,193,104,104,32,93
360 DATA194,120,169,139,141,0,3
370 DATA169,227,141,1,3,88,96
380 DATA160,0,165,34,141,104,194
390 DATA165,35,141,105,194,165,87
400 DATA141,106,194,165,88,141,107
410 DATA194,169,145,32,210,255,177
420 DATA87,133,20,200,177,87,133
430 DATA21,32,19,166,32,201,166
440 DATA173,104,194,133,34,173,105
450 DATA194,133,35,173,106,194,133
460 DATA87,173,107,194,133,88,230
470 DATA35,164,35,162,0,96,230
480 DATA122,208,2,230,123,160,0
490 DATA177,122,96,0,0,0,0,-1
```

Find:

This routine will find any and all occurrences of a string or command in a Basic program. When the comparison has been found, the line on which it was found will be listed to the screen and it will search for the next occurrence.

To call the Find routine, use SYS49492,dstringd. This will find all occurrences of string in the program. d is a delimiter character that marks the start and the end of the find string. This can be any character that is not in the string. The usual character to use is '/' but if the string 'PRINT' was to be found instead of the command, use the " character as d.

```
  0  C154  20FDAE    JSR  $AEFD
  1  C157  2063C2    JSR  $C263
  2  C15A  8559      STA  $59
  3  C15C  A200      LDX  #$00
  4  C15E  207FC1    JSR  $C17F
  5  C161  209DC1    JSR  $C19D
  6  C164  78        SEI
  7  C165  A917      LDA  #$17
  8  C167  8D0003    STA  $0300
  9  C16A  A9C2      LDA  #$C2
 10  C16C  8D0103    STA  $0301
 11  C16F  58        CLI
 12  C170  20ABC1    JSR  $C1AB
 13  C173  2018C2    JSR  $C218
 14  C176  20B1C1    JSR  $C1B1
 15  C179  4C73C1    JMP  $C173
 16  C17C  4C08AF    JMP  $AF08
 17  C17F  205DC2    JSR  $C25D
 18  C182  F0F8      BEQ  $C17C
 19  C184  C559      CMP  $59
 20  C186  F00D      BEQ  $C195
 21  C188  9D80BF    STA  $BF80,X
 22  C18B  E8        INX
 23  C18C  E040      CPX  #$40
 24  C18E  D0EF      BNE  $C17F
 25  C190  A217      LDX  #$17
 26  C192  4C37A4    JMP  $A437
 27  C195  A900      LDA  #$00
 28  C197  9D80BF    STA  $BF80,X
```

MACHINE CODE

```
 29  C19A  8622      STX  $22
 30  C19C  60        RTS
 31  C19D  A52B      LDA  $2B
 32  C19F  18        CLC
 33  C1A0  6902      ADC  #$02
 34  C1A2  8557      STA  $57
 35  C1A4  A52C      LDA  $2C
 36  C1A6  6900      ADC  #$00
 37  C1A8  8558      STA  $58
 38  C1AA  60        RTS
 39  C1AB  A200      LDX  #$00
 40  C1AD  A002      LDY  #$02
 41  C1AF  8423      STY  $23
 42  C1B1  A501      LDA  $01
 43  C1B3  29FE      AND  #$FE
 44  C1B5  8501      STA  $01
 45  C1B7  B157      LDA  ($57),Y
 46  C1B9  DD80BF    CMP  $BF80,X
 47  C1BC  08        PHP
 48  C1BD  A501      LDA  $01
 49  C1BF  0901      ORA  #$01
 50  C1C1  8501      STA  $01
 51  C1C3  28        PLP
 52  C1C4  D007      BNE  $C1CD
 53  C1C6  C8        INY
 54  C1C7  E8        INX
 55  C1C8  E422      CPX  $22
 56  C1CA  D0E5      BNE  $C1B1
 57  C1CC  60        RTS
 58  C1CD  E623      INC  $23
 59  C1CF  A423      LDY  $23
 60  C1D1  A200      LDX  #$00
 61  C1D3  B157      LDA  ($57),Y
 62  C1D5  F003      BEQ  $C1DA
 63  C1D7  4CB1C1    JMP  $C1B1
 64  C1DA  A557      LDA  $57
 65  C1DC  38        SEC
 66  C1DD  E902      SBC  #$02
 67  C1DF  8557      STA  $57
 68  C1E1  A558      LDA  $58
 69  C1E3  E900      SBC  #$00
 70  C1E5  8558      STA  $58
 71  C1E7  A000      LDY  #$00
 72  C1E9  B157      LDA  ($57),Y
 73  C1EB  8559      STA  $59
 74  C1ED  C8        INY
 75  C1EE  B157      LDA  ($57),Y
 76  C1F0  8558      STA  $58
 77  C1F2  0559      ORA  $59
 78  C1F4  F010      BEQ  $C206
 79  C1F6  A559      LDA  $59
 80  C1F8  18        CLC
 81  C1F9  6902      ADC  #$02
 82  C1FB  8557      STA  $57
 83  C1FD  A558      LDA  $58
 84  C1FF  6900      ADC  #$00
 85  C201  8558      STA  $58
 86  C203  4CABC1    JMP  $C1AB
 87  C206  68        PLA
 88  C207  68        PLA
 89  C208  205DC2    JSR  $C25D
 90  C20B  78        SEI
 91  C20C  A98B      LDA  #$8B
 92  C20E  8D0003    STA  $0300
 93  C211  A9E3      LDA  #$E3
 94  C213  8D0103    STA  $0301
 95  C216  58        CLI
 96  C217  60        RTS
 97  C218  A000      LDY  #$00
 98  C21A  A522      LDA  $22
 99  C21C  8D68C2    STA  $C268
100  C21F  A523      LDA  $23
101  C221  8D69C2    STA  $C269
102  C224  A557      LDA  $57
103  C226  8D6AC2    STA  $C26A
104  C229  A558      LDA  $58
105  C22B  8D6BC2    STA  $C26B
106  C22E  A991      LDA  #$91
107  C230  20D2FF    JSR  $FFD2
108  C233  B157      LDA  ($57),Y
109  C235  8514      STA  $14
110  C237  C8        INY
111  C238  B157      LDA  ($57),Y
112  C23A  8515      STA  $15
113  C23C  2013A6    JSR  $A613
114  C23F  20C9A6    JSR  $A6C9
115  C242  AD68C2    LDA  $C268
116  C245  8522      STA  $22
117  C247  AD69C2    LDA  $C269
118  C24A  8523      STA  $23
119  C24C  AD6AC2    LDA  $C26A
120  C24F  8557      STA  $57
121  C251  AD6BC2    LDA  $C26B
122  C254  8558      STA  $58
123  C256  E623      INC  $23
124  C258  A423      LDY  $23
125  C25A  A200      LDX  #$00
126  C25C  60        RTS
127  C25D  E67A      INC  $7A
128  C25F  D002      BNE  $C263
129  C261  E67B      INC  $7B
130  C263  A000      LDY  #$00
131  C265  B17A      LDA  ($7A),Y
132  C267  60        RTS
133  C268  00        BRK
134  C269  00        BRK
135  C26A  00        BRK
136  C26B  00        BRK
```

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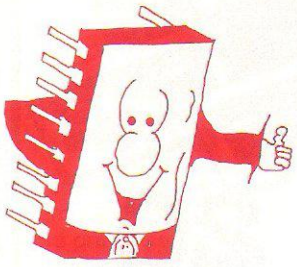

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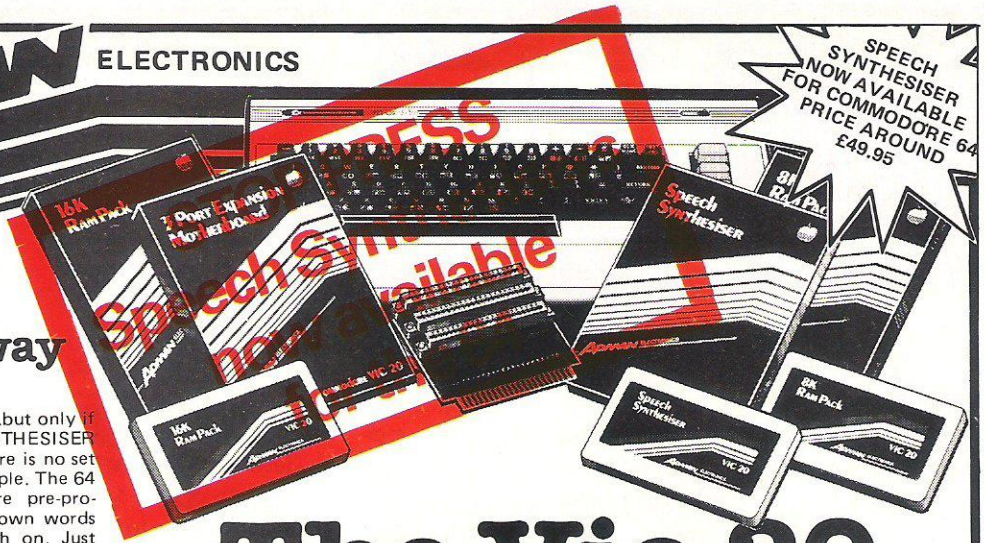

Add on the Adman way

The Vic 20 really can speak...but only if you use an ADMAN SPEECH SYNTHESISER. It's word power is endless as there is no set vocabulary. Yet operation is simple. The 64 elements of English speech are pre-programmed to let you put your own words together as soon as you switch on. Just imagine...program adventure games with characters that can actually talk!

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VIC 20/64 Adman Electronics Ltd. is a member of the Adam Leisure Group PLC

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The price for this complete system, the computer, floppy disk drives, printer, first 2000 bill sheets and staff training is from **£2745** + VAT, depending on choice of printer.

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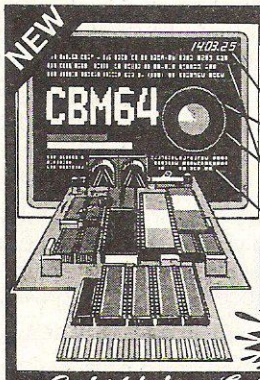

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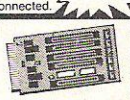

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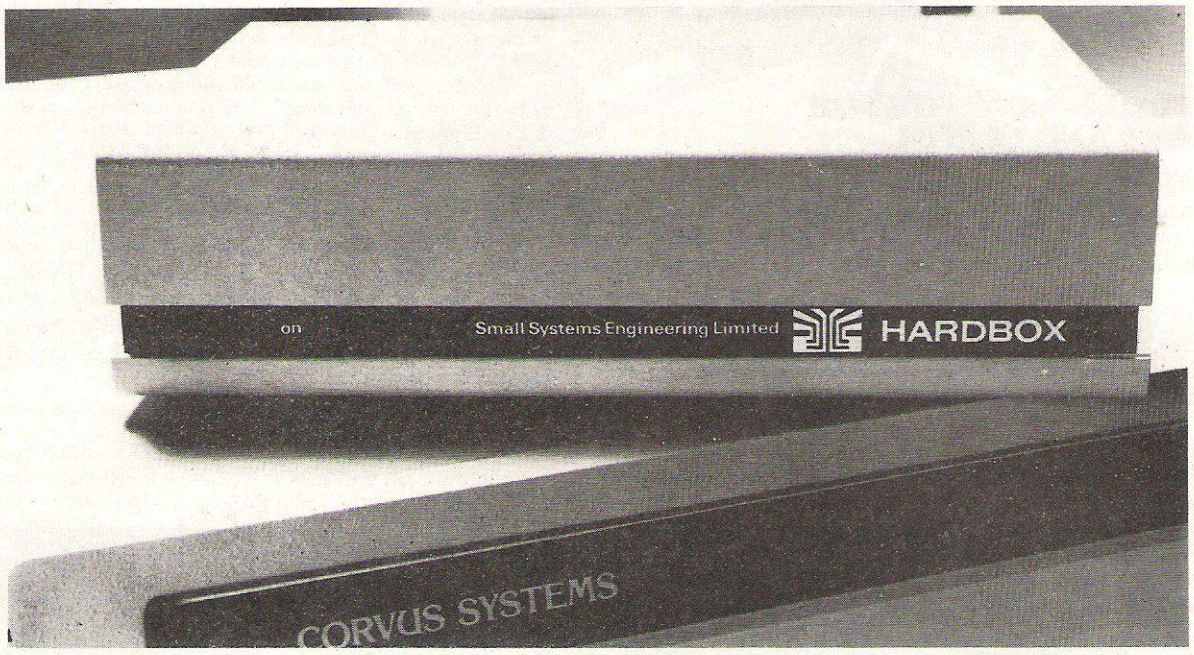

HARD DISK INTERFACE
HARDBOX is the intelligent controller that lets you add a Corvus hard disk drive to your Commodore computer. In fact, you can chain up to 4 hard disk drives of 6, 11 or 20 Megabyte capacities.

Compatible with CBM DOS versions 1 and 2, the HARDBOX operates with existing Commodore programs and appears to the Commodore as a high speed, high capacity floppy drive.

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Create a multi-user network by adding the Corvus Constellation multiplexer to your hard disk system. With a HARDBOX at each work station, up to 64 users can simultaneously access the same drive.

As a multi-user system, the HARDBOX provides:
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- Multi-user work areas for shared programs.
- File and record locking for shared databases.
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The HARDBOX supports the Corvus *Mirror Option*. This provides a high-speed, low cost means of backup, using a commercial video cassette recorder. Backup speeds of 7½ kilobytes per second let you save contents of a 10 MByte drive in less than 20 minutes. Video cassette capacity is approximately 100 Megabytes.

Hardware Requirements
- Commodore 3000, 4000, or 8000 series computer with BASIC 2 or 4.
- One HARDBOX and PET-IEEE cable per work station.
- Corvus bare drive and ribbon cable.
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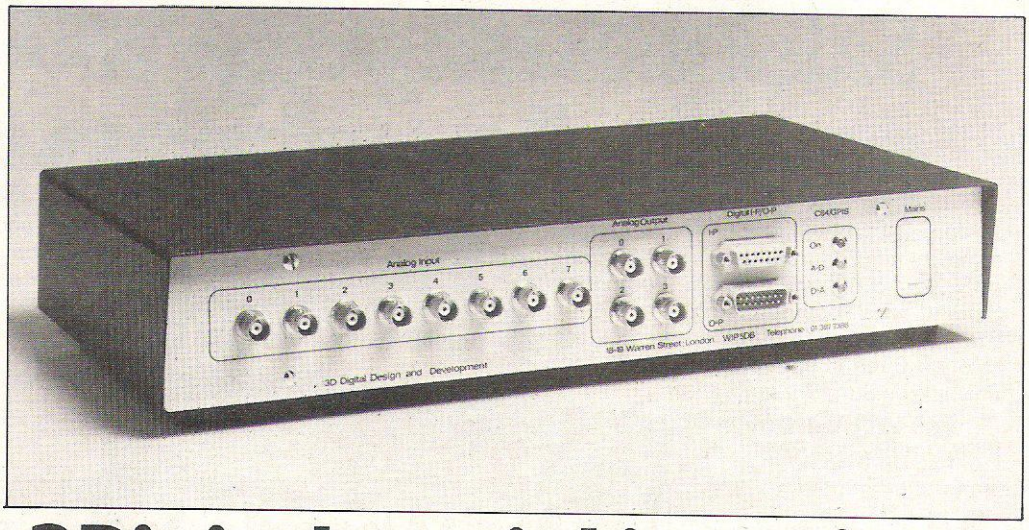
Computer Sales and Software Centre, Ltd., 190/192, Cranbrook Road, Ilford, Essex IG1 4LU. Tel: 01-554 3344.

ISG expand service

To cope with a growing demand for the after-sales servicing of computers and related products, ISG Data Sales have expanded their technical services and maintenance departments. Centres have opened in Manchester and Birmingham.

ISG currently provide an independent 24 hour service for Commodore micros as well as a range of printers, terminals and disk drives. Emergency call outs and contract service work are dealt with.

Contact: ISG Data Sales, Wellington Industrial Estate, Basingstoke Road, Spencers Wood, READING RG7 1AW. Tel: 0734 884666.



3D's industrial interface

Digital Design and Development (3D) have introduced the GPIS (General Purpose Interface System), an interface designed specifically for low budget industrial applications. It retails at £700 + VAT.

It offers a combination of analogue inputs and outputs with 12 bit resolution. In addition there is an 8 bit port for digital inputs and one that provides an open collector Darlington stage. The system is self-contained with integral power supplies, connectors, indicators and a ribbon connector to the CBM 64 memory expansion port.

Contact: 3D Digital Design and Development, 18/19 Warren Street, LONDON W1P 5DB. Tel: 387 7388.

Qume graphics terminal

The QVT 211 GX, a Qume terminal from ISG Data Sales combines graphics capabilities with normal business computing features. It retails at £950.

On the adjustable 14 inch screen, the QVT 211 can display the separate and independent graphics memory at the same time as its alphanumeric memory. It has its own built-in graphics mode plus a menu set up mode instead of Dip switches.

Contact: ISG Data Sales Ltd, Wellington Industrial Estate, Basingstoke Road, Spencers Wood, READING, RG7 1AW. Tel: 0734 884666.

Legal system

Cortex Computer Systems have just introduced Lawcomm, a system suitable for use in a small practice. It enables solicitors to extract information from the Eurolex legal database.

The complete configuration, designed for the 8000 series, costs under £4000 and includes 2 MB disks, daisy wheel printer, modem and the communication software. Other functions include word processing, budgeting, time recording and accounting software can be used on the system.

Contact: Cortex Computer Systems Ltd, Cortex House, 5 Union Street, BEDFORD. Tel: 0234 217721/2.

Modular mate

A modular version of their officeMate Accounting software has been developed by the Micro Computer Centre. The modules vary in price, but the full system costs £1700.

The Modules include the Cash Book, Sales Book, Purchase Ledger, Nominal Ledger, and a Payroll. Altogether there are 382 different modules. Each of these can be bought individually or linked to provide a totally integrated accounting system. The system can be tailored to fit the customers needs.

Only one working disk is needed as all the modules can be incorporated onto the original disk. The software is menu driven and includes a main menu and the appropriate sub-menus.

Contact: Micro Computer Centre, 28 Sheen Lane, LONDON SW14. Tel: 878 7044/5/6/7.

Free brochures

The Computer Supplies Company are giving out free colour brochures on fire proof safes, cabinets and computer accessories.

Floppy disks and magnetic tapes are becoming increasingly popular as the media on which important business information is stored, but fire is a threat and years of work could be wiped out in minutes.

Contact: Unit 23 Henlow Industrial Estate, HENLOW, Bedfordshire, SG16 6DS. Tel: 642 813511.

Sales training course for dealers

Systemate Ltd have launched a sales training course, specifically for computer dealers. Starting on a Friday morning, the delegates are taken through three intensive days, finishing on Sunday evening.

The course price of £250 per person includes meals and accommodation. Wives (or husbands) and children are accommodated free of charge and the courses are held in the most convenient Holiday Inn for all the participants.

The basic selling skills are taught along with role playing exercises. Emphasis is laid on the pre-approach work and after sales service. Professional presentation and customer relations are also discussed.

Contact: Systemate Ltd, 77 Laleham Road, STAINES, Middlesex. Tel: 0784 62588.

Long distance driver

Data transmitted over distances of more than 30m tends to corrupt or deteriorate in quality, so Inmac developed the Datadriver which could solve the problem. Two versions are available; a pair powered from the mains, retailing at £349 and a self contained pair powered from pins 9 and 10 of the computer at £289.

One datadriver is plugged into the RS232 socket and the other is attached to the peripheral. A thin flexible cable links the two. The peripherals can be located up to a mile apart.

Contact: Inmac (UK) Ltd, Davy Road, Astmoor, RUNCORN, Cheshire, WA7 1QF. Tel: 09285 67551.

Monitor

Microvitec's new Universal Monitor was launched recently. It is a colour monitor compatible with other equipment and capable of accepting inputs in different signal formats.

The Colour Monitor accepts RGB and PAL-encoded signals direct from the CBM 64 so that it can produce quality pictures and sound from a camera or videorecorder. Two screen sizes are available – the 14 inch model with the audio facility retailing at £259 + VAT and the 20 inch model with three power inputs at £385 + VAT.

Contact: Microvitec Ltd, Futures Way, Bolling Road, BRADFORD, BD4 7TU, West Yorkshire. Tel: 0274 390011.

New modems from Scicon

Scicon Ltd have introduced two new Modems, expanding their range of data communication products; the V21 Buzzbox retailing at £70 + VAT and the four function 2123 GT at £498 + VAT.

The Buzzbox operates at a speed of 300 bps and enables Commodore users to communicate with other computers and to access into a range of information networks – Viewdata, Electronic Mail for instance.

The 2123GT, a more sophisticated model operates at speeds of up to 9600 bps and has a number of facilities including error correction and auto dial.

Contact: Scicon Ltd. Tel: 01 580 5599.

Consult Zebra

Zebra Computer Services have set up a Computer Consultancy with full technical maintenance services to serve the East Midlands and East Anglia.

Large and small companies are dealt with and Commodore compatible hardware and software is supplied.

Contact: Zebra Computer Services Ltd, 9-10 St George Street, STAMFORD, Lincolnshire PE9 1BT. Tel: 0780 54695.

Worker for hire

A service providing specialist workers for the data processing industry has been started by Tangent.

Systems analysts, programmers, project managers and business analysts can be hired for use on projects or as temporary replacements for absent staff. In addition they will provide a project team to help clients augment a Data processing system.

Contact: Tangent Computer Services Ltd, Fairfield House, Fairfield Road, BRENTWOOD, Essex CM14 4LR. Tel: 0277 255755.

Paper handlers

Swingline, an American Company have produced four paper handling devices specifically for data processing; an upright and Table Top model for both the Decollator and the Burster.

The size, weight and length of the sheets that the equipment can handle varies for each model.

Contact: Swingline, 32-00 Skillman Avenue, Long Island City, N.Y. Tel: 11101/212 729 9600.

Mator dolphin for a PET

Mator Systems have added the Dolphin 3 to their range of Protocol Converter Systems.

The equipment, costing under £1000, enables users to link PET micros with IBM mainframes using 3780 and 2780 protocols. The unit also provides a simple plug-in IEEE 488 connection to the PET.

Contact: Mator Systems Ltd, 134-140 Church Road, HOVE, Sussex. Tel: 0273 720451/2.

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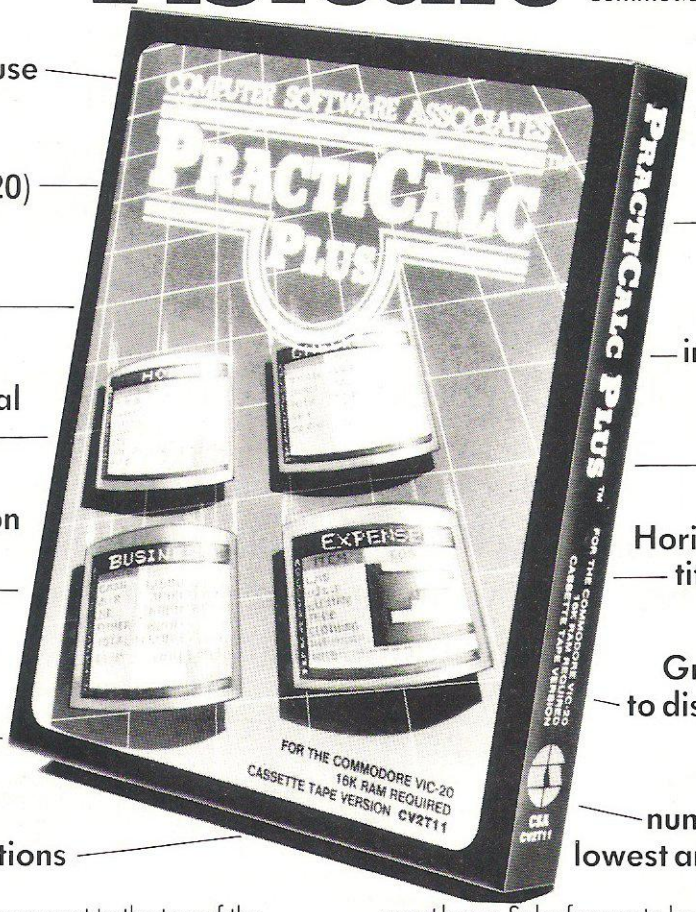

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And no wonder since this program from Computer Software Associates provides 16K VIC 20 and Commodore 64 users with a real business spreadsheet to use at home. Sales forecasts, budgets, cashflow projections, financial modelling, are easy with Practicalc.

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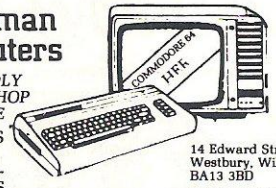

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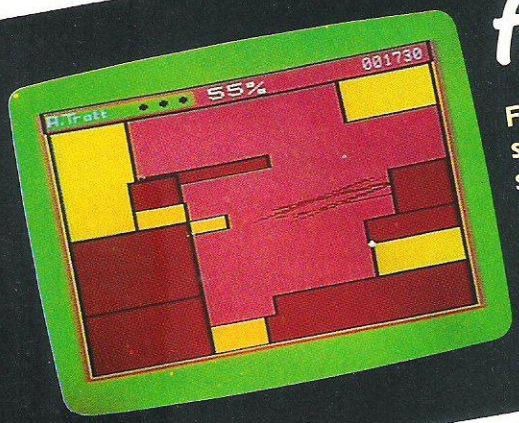

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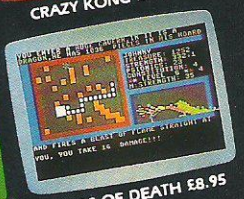

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for business

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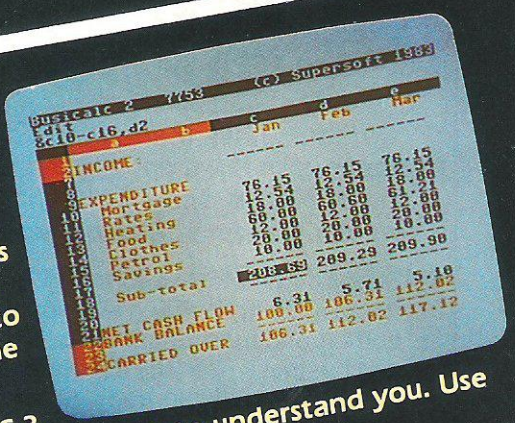

Whether you choose BUSICALC 1, BUSICALC 2, or BUSICALC 3 you'll get a program you can understand – and one that almost seems to understand you. Use it in the home, use it for teaching, use it at work – it'll save you time and money.

for programmers

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There's much more for the 64 in the SUPERSOFT catalogue. Ask your computer dealer for a copy, or Phone 01-861 1166.

The Best 64 Software

SUPERSOFT, Winchester House, Canning Road, Wealdstone, Harrow, Middlesex, HA3 7SJ Telephone: 01-861 1166

STORR your accounts

This month we look at two accounting packages: Storr from TM Software Systems and the Integrated Accounts System LB13 from Electronic Aids. Both operate on the 8032 with an 8050 disk drive, although the Integrated Accounts System will also run on the 8096, with a version for the 700 under development. Both have similar features (and similar drawbacks), the main difference being in price. The Electronics Aids package at £400 plus VAT, costs £350 less than TM Software' package despite having extra facilities.

STORR

STORR is the stock control and accounting system for the 8032 developed by TM Software, whose business philosophy is 'seeing is believing'.

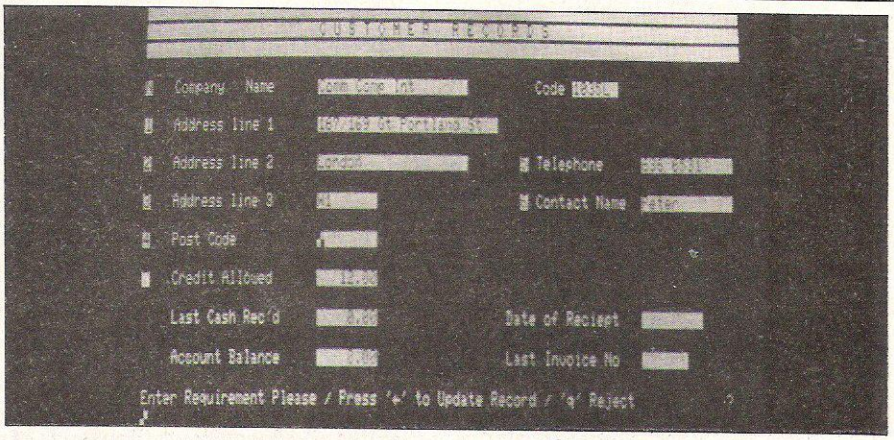
Hardware requirements are an 8032 with an 8050 disk drive and a Commodore printer. The program was written for the 8024 printer, but by changing the secondary address to seven it should be possible to use the 8023 or 8026.

Computer jargon is thankfully lacking in the manual which accompanies STORR, making it ideal for businessmen who want a quick and easy introduction to office automation.

After plugging in the dongle and loading the two disks (one containing the program, the other a demonstration disk), the first step is to enter the current date. This is simple, but it would be helpful if the cursor jumped from one input area to another rather than having to put a comma between each set of figures. However, this is the only area in the program that requires punctuation. One unnerving feature of STORR, which is common to many accounts packages, is that between the entry of the date and the screening of the main menu the screen blanks out for a seemingly long period.

There are 15 options to choose from on the main menu and, as with most systems, it is best to go through the program chronologically. If the user goes straight into some parts of the system, he will not be able to get any further due to a lack of information.

The first option on the main menu contains the system parameters, most of which are user amendable. Bypassing this option, the first major step is to create all the business records the format for which is provided on the demonstration disk. The records are protected by programmer-defined security which can be overriden by the master password.



Errors made before data is saved onto disk are not easily amended. As the cursor can not be moved around the screen at the will of the user, the prefix of the line must be entered before any corrections can be made.

As this is an integrated system with data being updated as trading progresses, not all of the display is ammendable. However, this part of the system is not free from errors. In the supplier records section of this program an error in the screen layout has resulted in two locations being labelled 'number seven' – telephone numbers and credit. This means that data entered as a telephone number enters the location allocated for the amount of credit which could lead to all kinds of problems!

Once saved onto disk, data can be updated by entering the relevant account number and calling up an account.

A discount structure provides four separate price levels. Stock records also show the actual location of stock in the warehouse and the amount of VAT per item. VAT is one of the user-defined parameters in the system, which has four available VAT codes.

The number of records which can be catered for by STORR is limited by the size of the disk. However, any number of disks can be used depending on the nature and size of the business. Typical storage would be 2000 stock accounts, 500 sales accounts, purchase accounts, invoices, cash received and paid entries, and delivery blocks.

Product: Accountancy package;
Price: £750 plus VAT;
Documentation: Jargon-free manual;
Applications: Business;
Capabilities: VAT, stock control, credit control;
Minimum hardware: CBM 8032, 8050 disk drives, 8023/24/25 printer;
Company: TM Software, Address: 105 Uxbridge Road, Hanworth, Middx. TW13 5EH. Tel: 01-755 0713

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DEALER ENQUIRIES WELCOME

INTEGRATED ACCOUNTS SYSTEM LB13

Emphasis on data security is one of the major advantages that Electronic Aid's Integrated Accounts System LB13 has over similar packages. In addition to a dongle which contains all of the security, it is impossible to enter the system without the correct password. And even when the user is into the main system, there are several other passwords needed before the user can enter the different sections provided by the main menu. These passwords are written and stored in code at a secret location on the disk.

Once the program has been loaded the user encounters the same problem seen in this stage of the STORR package. That is the screen is left blank for a short period and the user wonders if anything is happening.

With the disk formatted, the user has to set up the reports, invoices and ledgers, then decide on the number of accounts required before any data can be entered into the system. In this respect the program is quite large and it is possible to put 600 customer or supplier records onto one 8050 disk with a maximum of 40 invoices per record.

Again the first data to be entered is the date followed by the accounting period. The built-in calender facility displays the correct day on screen as a final check to ensure that the date entered is correct.

The next step is to set-up the invoices and ledgers. The ledger system is simply a series of records of transactions relating to the financial affairs of the business. With purchase ledgers, transactions are related to the name of the supplier, whereas with the nominal ledger all transactions are analysed between accounts where the name matches that of the transaction.

The nominal ledger includes records of money which has been borrowed or loaned and the sales ledger records invoices between the company and the customer. Because of the double entry principle operated by the ledger system, totals of unpaid purchases and sales should equal those of the opening balances on the other ledgers.

Fixed costs such as overheads, profit and loss are pre-set reports in the nominal ledger. On loading the nominal ledger program, the user gains immediate access to ledger reports enabling him to examine the audit trail, print the balances and access the cash book and nominal journals.

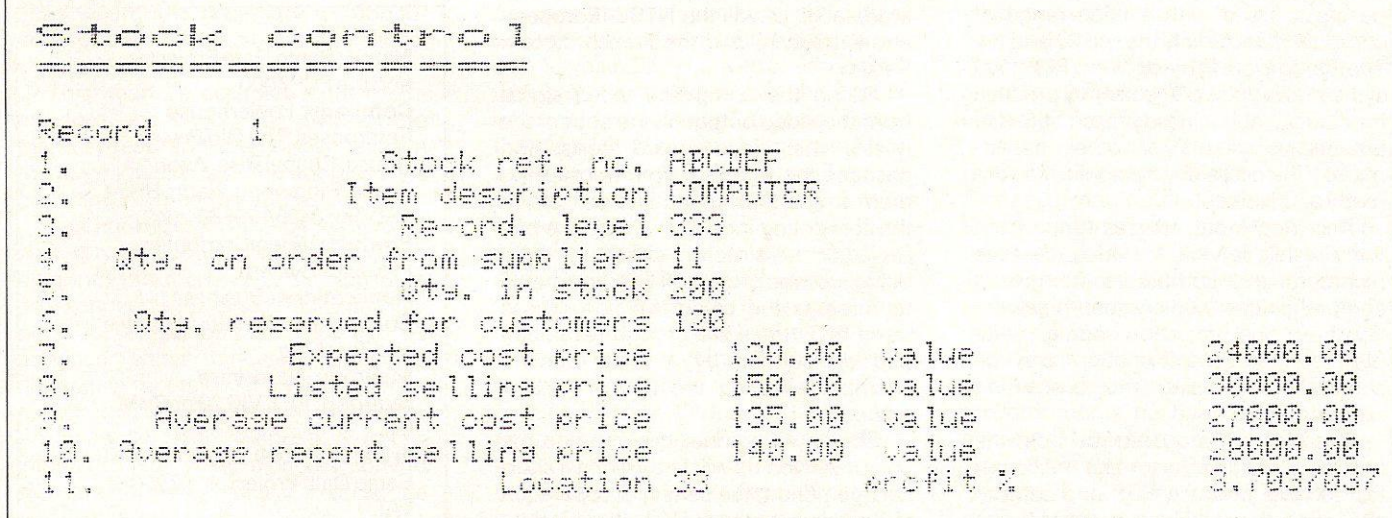
Customer records can be updated in each of the three ledgers and lists of records can be printed out.

Keeping track of current stock levels is catered for to a certain extent, but the stock control routine is not completely integrated with the rest of the package due to lack of memory. Instead, it is accessed direct from the main menu. (In order to make this routine fully integrated the user would have to sacrifice a number of nominal accounts and possibly encounter a reduction in the operating speed of the system. Therefore Electronic Aids recommend that the 700 version should be used if full integration is required.)

The stock record can be amended at this stage. When data is being amended the cursor appears at the bottom of the screen and the line number has to be entered before amendments can be made. Payroll is another area of business financial management which cannot be ignored which is incorporated in this accounting package. This routine includes all the features generally found in a payroll program. It does not, however, have any facility to erase employee records should an employee leave before the end of a tax year. The user must wait until the end of the tax year and then mark the files as vacant so that it can be used for further employees.

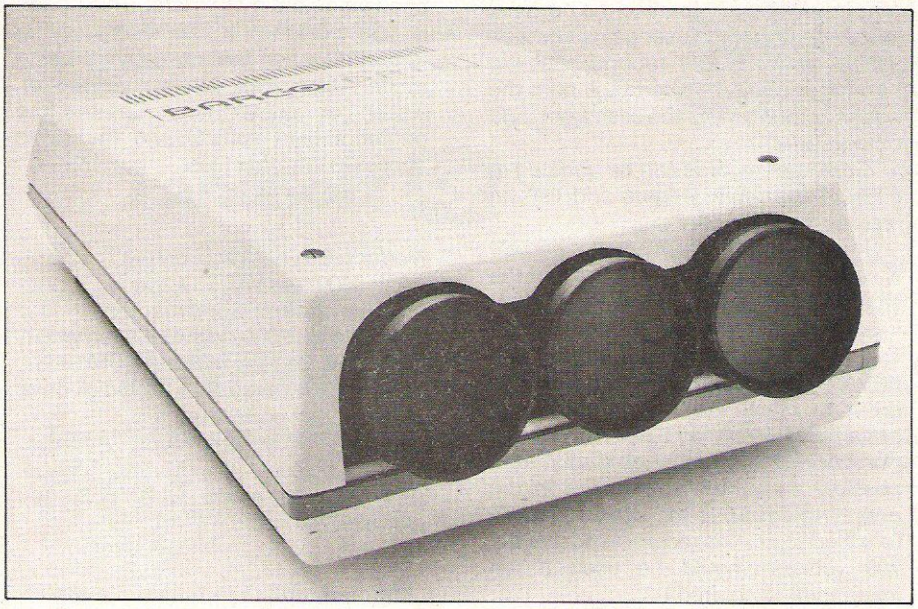
Another interesting section of this program is the utilities option which appears on the main menu. This option is selected when a new disk is being formatted or a backup copy is being made. Directories can be viewed on screen or printer (any Commodore printer should suffice) and the same applies to the other files.

Product: Business accounting;
Price: £400 plus VAT;
Documentation; Good manual;
Applications: Business Management;
Hardware requirements: CBM 8032, 8096 or 700 with 8050 or 8250 disk drive and any Commodore printer;
Company: Electronic Aids, Address: Mythe Crescent, The Mythe, Tewkesbury, Gloucestershire GL20 6EB. Tel: 0386 831020.


Stock control
Record 1
1. Stock ref. no. ABCDEF
2. Item description COMPUTER
3. Re-ord. level 333
4. Qty. on order from suppliers 11
5. Qty. in stock 200
6. Qty. reserved for customers 120
7. Expected cost price 120.00 value 24000.00
8. Listed selling price 150.00 value 30000.00
9. Average current cost price 135.00 value 27000.00
10. Average recent selling price 140.00 value 28000.00
11. Location 33 profit % 3.7037037

Business projections

This month we look at two very different products for the business market. The GPIS from 3D is a useful tool for anyone who wants to feed normally unacceptable signals into a computer while the Powerhouse projection systems enable a huge display of the information that appears on the monitor screen.



Powerhouse Enterprises have designed a video projection system for use in business. Used with a wide range of computers, including the Vic 20 and 64. The Barco Data Projector and PCP 1000 system allow the office user to produce more efficient business presentations to prospective clients or other departments. The occasions for application are many and varied.

Accepted input sources range from the Prestel service to video cassette recorders and computers. To give a comprehensive audio/visual presentation from one projection source, multiple sources of information can be combined by using the processing switch.

The external processor on both the b/w Barco Data Projector and the colour PCP100 will produce RGB and composite video signals. Users in the U.K. are assured the standard PAL signal input (which has 625 lines per screen) will be acceptable, as will the NTSC (European and American) and the French system Secam.

Taking the composite video signal from the video output on the back of the micro, the video board sorts and decodes the signals before transferring them to the RGB input. Newcomers to the computing industry will find the b/w projector the simplest to set up, there being just one projection CRT compared to three in the colour version. These three CRT tubes are of high resolution and surrounded by a liquid cooling chamber allowing the use of greater power.

Should a beginner decide upon the colour version he will find, within a short useage period, the setting up operation to be a simple matter. With all projectors focusing is the most important aspect to be considered.

To gain the best possible effect when making a presentation with one of these machines the designers have set up a test grid consisting of the three spectrum colours.

The lines forming the grid must be matched perfectly to ensure the legibility of the projected presentation.

These projectors are hooked up to the back of a Vic 20 or a CBM 64 via an interface, (which in the case of this review was provided by Small Systems Engineering – many thanks). The interface converts the monitor output from the computer to a standard PAL signal for the projector.

The Barco Data Projector and the PCP 1000 are already used by such companies as IBM, ICL, the Wellcome Foundation, Cancer Research, BP and Shell. These machines could also be used in a teaching environment.

Name: Barco Data Projector and the PCP 1000.
Company: Powerhouse Enterprises, The Old Power House, Chapel Rise, Avon Castle, Ringwood, Hants BH24 2BL. Tel: 04254 79569/2043.
Product: Video/Computer Projector System.
Applications: Business Conferences, Training Courses and Teaching.
Minimum hardware required: PET, VIC 20 or CBM 64
Price: PCP 1000; £10,500 + VAT Barco Data Projector; £7,900 + VAT.

From A to D

The interface reviewed here is the General Purpose Interface system from 3D Digital Design and Development, designed for use with the Commodore 64. It can also be used with the Vic-20, although this requires a different set of interface cables.

3D's General Purpose Interface System is a sophisticated piece of electronics which converts information from analogue signals to digital signals and vice versa. Until the advent of computers such conversions were hardly ever necessary, but since computers can really only understand numbers it is essential that any information to be fed into the computer is digital.

This particular interface system has been put to some interesting applications. One of 3D's OEM customers is using the General Purpose Interface System at the heart of an automatic fermentation rig, the idea being to carry out work in bio-genetics. The company experiments with different strains of fermentation germs under different conditions and monitors their growth. It has to have the ability to monitor and control both analogue and digital signals and this is where the interface system comes in.

The system is also used by the engineering department at Oxford University, and 3D says that its General Purpose Interface System is appropriate in any production or laboratory conditions where it is necessary to monitor and control both analogue and digital signals.

This interface occupies eight memory locations which are divided into memory-read and memory-write, with the three lower bits of the address lines providing the memory address.

It is hooked-up to the 64 via two 25 way d-type ribbon connectors which plug into the memory expansion port, one connector for digital input and the other for digital output. Input can be provided either by eight analogue differential inputs or 16 analogue channel inputs. These signals can be bi-polar or uni-polar. The General Purpose Interface System can, of course, convert signals both ways – digital to analogue and analogue to digital.

With the analogue to digital converter there are just two configurations. The first of these is the convertor reference voltage. Voltage to this convertor is controlled by a multi-channel potentiometer (pot) which acts as a sensitivity control. Once it has been calibrated, it is possible to set 10 conversions per second without using the on-board oscillator on the convertor. When the oscillator is used, the speed can be increased to as much as 30 conversions per second.

When digital information is being converted to analogue data, the output voltage is switch selectable from a range of 0-10 volts. Each convertor associated with the five switches has three pots which perform various functions. Two of these set the value sent to the convertor as 4095 (which provides full scale output) and 0 (whichprovides minimum output). The inclusion of the third function on the unit will, however, eliminate the voltage scale specified on the original unit as it enables the maximum output value to be exceeded.

The two convertors in the interface can be programmed using BASIC, 6502 or 6501 Machine Code. All the user has to do is to Peek and Poke the specified memory locations. However, because all the analogue signals pass through a multi-plexer before reaching the convertor the required channel must be selected before the data can reach the convertor.

Three data lines leading from the micro are used for channel selection, while a fourth is used to select which of the convertors will supply the data to the micro.

The front panel of the unit houses the eight analogue input channels, each of which has a five-way switch to select the output voltage. Each channel is capable of handling 50 volts and 400 mega amps so it is possible that the system could be used to drive motors.

In addition to the analogue input channels, there are eight digital input channels that allow the user to monitor eight digital inputs.

A comprehensive manual accompanies the General Purpose Interface System, giving a full description of the configuration of the system and the necessary connections to the micro. There are also several sample programs showing how to send analogue and digital signals.

The unit, which also runs on the BBC and Apple, has not been officially tested by Commodore, but has been rigorously tested by customers of 3D. In conclusion, 3D's General Purpose Interface System is a very useful piece of equipment for specialist applications.

8000 ways to get your

Many software companies are now producing accounts packages to enable hours of work by hand to be accomplished in minutes by a relatively inexperienced operator. In this month's product survey we take a look at a selection of accounts packages available for the 8000 series, concentrating on the payroll element. First we take a general look at the facilities provided by a payroll program. Then we focus on some of the available software.

Speed and accuracy are the main benefits of letting a computer run your payroll. The average time needed to enter details for each employee during a payroll run is just 12 seconds, the computer does the rest. Mistakes are completely eliminated as, given the correct data, a computer will always get its sums right and never looks up the wrong code number, week number or tax table. Another benefit is that a computer can provide useful statistics such as the cost of labour, hours worked, and monthly or end of year analyses.

When choosing the payroll program most suited to your business, one of the first considerations to be made is the choice of format. Programs are available on cassettes, floppy disks and hard disks. Unless you are prepared to invest in more hardware, your choice must be limited to software developed especially for your existing system.

Requirements for a payroll program will vary for different businesses, but the fundamental requirements are the same. Any payroll program should be flexible enough to accommodate differences in basic pay, tax, overtime and other variables. Statutory Sick Pay is now a legal necessity so SSP calculations are another essential feature.

Most payroll programs allow hourly, weekly and monthly paid staff to be mixed on to the same disk in any order. Overtime rates are generally set by the user, with some packages catering for anything up to 11 different rates.

The treatment of Statutory Sick Pay varies slightly but in general a payroll program will calculate the amount due to be paid and automatically compute and insert the correct amount on the payslip. Some incorporate a 'help' section which leads the user through SSP legislation as set out in the Employer's Guide to SSP. The SSP paid total is held and overall totals for the year to date are provided.

When tax codes change, the user just enters the changes for each code and then the computer automatically amends each employee's tax code. Changes in tax rates however, aren't quite as simple. Any change in legislation will require either an updated disk or a program which updates the payroll disk. (Check the service provided with individual packages).

A choice of payroll run method is offered by some programs. For example, payslip printed out after each entry; all entries made first, then continuous print run; immediate payslip run without entries; or a selection of individual employees. Payslip stationery varies with options of plain or pre-printed payslips, and pre-perforated sheets. Some packages allow you to design your own print formats. Payslips and copies are generally produced side by side so that employers' copies can be kept in a continuous strip for convenience.

To allow for the fact that a computer may suddenly be required for another use, some programs incorporate an interrupt system whereby in the middle of entering pay run information the whole system can be closed down at the touch of a key. On re-running the Pay Run program it will automatically go back to the point of the close down so that entering can continue.

For cash payments, programs can offer coin analyses indicating the required notes and coins for pay packets. Others automatically print Giro slips or cheques for employees that have been designated to be paid in that manner.

All payroll programs offer several analyses ranging from an analysis after each pay run and such liabilities as tax, National Insurance and refund of SSP at the end of each month, to a summary of the whole year's operation together with all forms required for annual returns printed automatically.

Any necessary amendments to data (change of name, bank details, rate of pay, etc.) can easily be made by those with access to the system. In the event of an employee leaving, some programs allow the user to delete the employee from the system, displaying P45 details. Others have no routine for deleting an employee until the end of the tax year. Files of employees who have left can then be re-used for a new employee.

While there is a limit to the capacity of each data disk, many systems allow the analyses from disks to be combined making the system capacity almost limitless.

Payroll packages can also cater for businesses with more than one company, all running separate payrolls. A company's name and details of how the payroll is to operate are kept on the payroll data disk, and not with the

payroll sums right

Tax Wk/Mth	Date	Dept	Number	Company
Week 21	26 Aug 83			Computastore Limited
Timothy Smith		01	001	

GROSS PAY ELEMENTS:				STANDARD DEDUCTIONS:		
Basic	@ 2.00	35	70.00	Pension		-7.01
O/Time 1	@ 2.67	2.5	6.68	National Insurance		-12.62
O/Time 2	@ 3.50		0.00	Tax		-28.50
O/Time 3	@ 4.00	6	24.00	AFTER TAX ADJUSTMENTS:		
Bonus A			12.00	Union A		-0.15
Bonus B			2.30	Overalls		-0.20
Shift			2.00	Savings		-5.00
Attend	@ 1.00	4	4.00	Mileage	@ .17 22	3.74
Supervisor			5.00	Expenses		4.54
Piece Wk	@ .15	41	6.15	NET PAY	£	94.98
Sick Pay (SSP)		1 Days	8.05			A/pay

Taxable Gross	Gross to Date	Tax to Date	Tax Code	Total NI	NI Number
133.17	2125.82	396.60	198 H	28.67	AB 21 34 52 A

Copyright Computastore Ltd. 1982, 1983

A computerised payslip produced by Computastore's SuperPay payroll program.

program. This means that each company's details can be set up along with the employees' data and run using the same program.

Operation of a payroll program is always easy, but this does not mean that records can easily be tampered with. Access to data is only possible with a security password or code which can be changed when required. As a further security, some programs will only operate when a security key (provided with package) is fitted to the computer.

In conclusion, by running a computerised payroll a company can perform the essential function of paying employees with more speed and accuracy than is possible by hand. It is simple to operate and payroll records are in less danger of being tampered with than they are in a locked filing cabinet.

Officemate

Micro Computer Centre has developed a modular version of its OfficeMate accounting software system which includes a payroll module.

Designed to the Inland Revenue's Specifications for Computerised Payroll, the program covers hourly, weekly and monthly paid staff on one disk.

All tax and NI codes are covered. There are five pre-tax adjustments with descriptions and five after-tax adjustments with descriptions, two of which can be pre-set in both cases. Three rates of overtime are available and total hours of overtime at each rate are calculated.

Four options are given for running the payroll: payslip print-out after each entry; all entries first and then continuous print-out; immediate payslip print run without entries; or a selection of individual employees.

Payslips are printed out on plain paper together with a copy. Employee cost analysis in up to nine cost centres are provided. At the end of a year, the program automatically zeroes titles and P35 listings are provided. The program is suitable for contracted-out employment and mixed employment.

In the event of new legislation, Micro Computer Centre offers a service providing all the payroll updates regardless of how many there are in a year, for a fee of £50, or £25 for each payroll update required.

SuperPay

Computastore's SuperPay payroll program is designed for newcomers to computers, with memory screens guiding the user through the system.

All tax and NI codes are covered by the program which automatically calculates tax and NI for each employee for weekly, fortnightly, monthly or irregular payment periods. Up to 11 Gross Pay elements are available and five after-tax adjustments for each employee. SSP is calculated.

Pension contributions are calculated either as a percentage of gross pay or as a flat rate contribution. Flat rate or percentage Holiday Pay accruals can be accumulated and the tax week for either the whole payroll or individual employees can be advanced when holidays are taken. Holiday pay stamps which are taxable but not subject to NI can be entered.

Individual and departmental coin analyses are printed for those employees paid in cash. For those paid by credit transfer, SuperPay prints giros and summary listings. An employee's net pay can be rounded up or down to a convenient amount. SuperPay can also calculate each employee's net pay without stopping between payslips.

Totals for up to 20 rates of pay or adjustments (user-defined) are printed for up to 99 departments.

Year-end documents (P60, P11, P35) are printed for all employees including leavers.

In the event of budget increases, SuperPay automatically updates each employee's tax code by a fixed amount. PAYE and NI update disks are sent automatically to end-users for a small charge. All new versions of Superpay include Autopay as standard to cope with the major banks new regulations. 600 employees can be stored on a single disk.

AT LAST, THE 132 COLUMN PRINTER FOR THE BUSINESS MICRO COMPUTER USER

FULLY COMMODORE COMPATIBLE

The MT180 matrix printer is setting the standard in price/performance for the business micro user. The 160 cps gives you high throughput whilst its standard 132 column width is ideal for the latest accounting and spread sheet software.

With the MT180 you can easily use your word processing package. Just one code stream sets the printer to 40 cps correspondence quality and all codes associated with a daisy wheel printer.

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Problem free interfacing — buffered serial and industry standard parallel.

At Mannesmann Tally we just do not believe in the word option.

For the user we have the on-going support only a manufacturer can totally provide.

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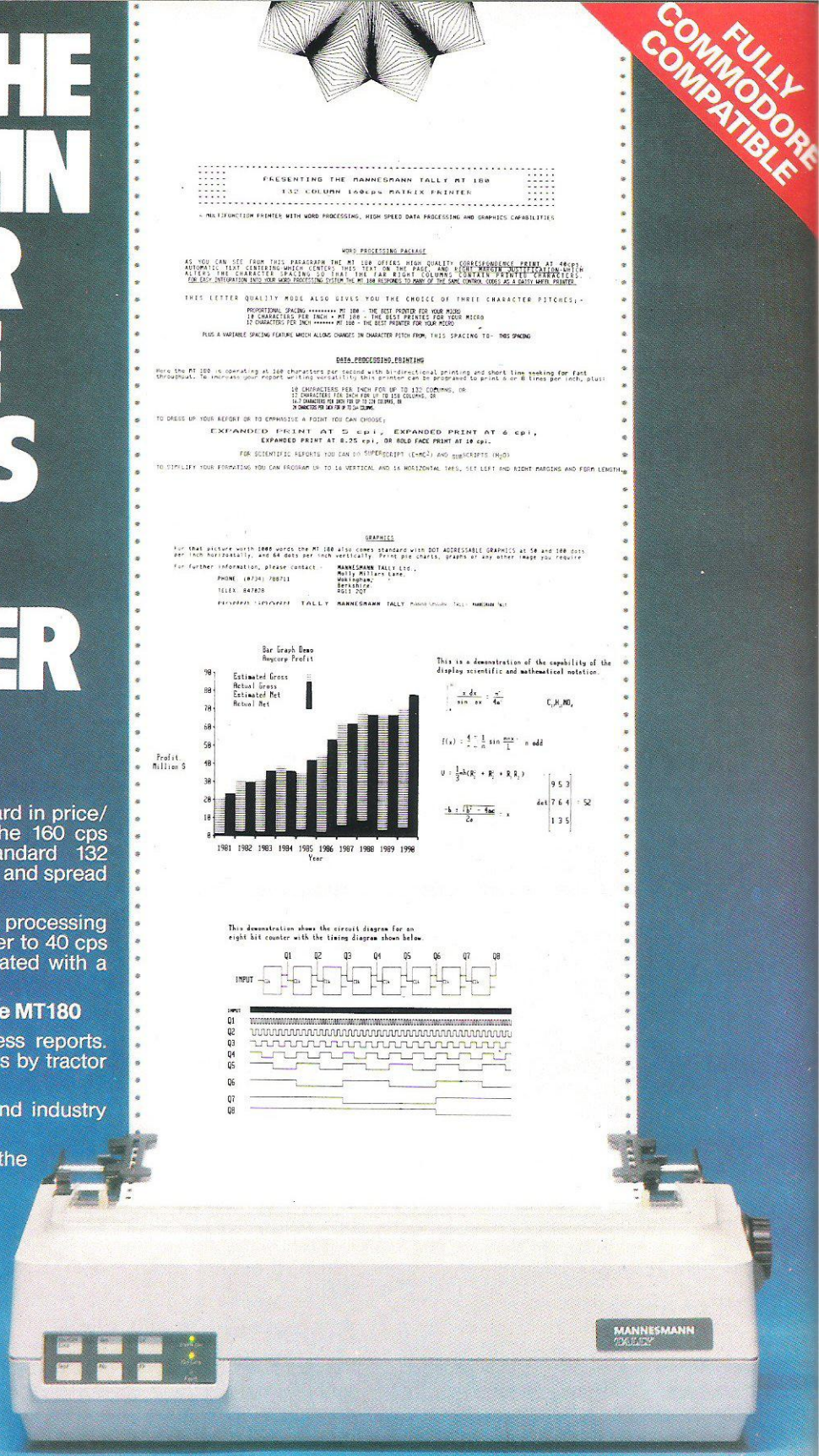


THE MT180 FROM MANNESMANN TALLY

MANNESMANN TALLY

M-T DIRECT

Note to microcomputer dealers — if you would like to handle these products then ring Geoff Thomas or Terry Bell on the M-T Direct lines — Wokingham (0734) 791619 and 791533.

Molly Millars Lane, Wokingham, Berkshire RG11 2QT
Tel: (0734) 791868 Telex: 847028

Integrated Tabs Payroll

Raindrop Computer's Integrated TABS payroll can be used as a discrete unit, or can be integrated with the Nominal Ledger and Job Costing modules.

The system covers nine pre-tax pay schemes. These have a number of overtime rates, bonus rates and other additions and deductions, all of which are user-defined.

There are also nine post-tax schemes, which each have five post-tax adjustments. Some of these values can be over-ridden by entries in the employee file, providing an additional choice.

Automatic calculations for tax and National Insurance are calculated according to government regulations. A choice of three types of payroll stationery is offered for payslip format. Details required to complete P45, P60, P35 and P11 forms are also available.

The payroll module includes the option to make alterations to records where operator errors are detected. Statutory Sick Pay is not catered for by this module, but Raindrop has an SSP module which can be used as a discrete module or linked to the Payroll. All functions necessary to administer the Government scheme are included in the module.

Electronics Aids Integrated Accounts System

The Integrated Accounts System from Electronics Aids incorporates a payroll program which is accessed from the pay menu. It caters for seven overtime rates defined by the user. There are two pre-tax adjustment rates and also two after-tax adjustment rates.

Deduction cards are in a similar style to the manual deduction sheets issued by the Inland Revenue. There is a choice of payroll run method; individual employee payroll run, or a full payroll run. A coin analysis is provided for cash payment. The program also provides a pay run cost analysis.

National Insurance, tax and Statutory Sick Pay can all be updated after any Budget changes, but only if there is no change to the tax system or to free pay tables.

Summaries of pay, tax and National Insurance are also available. The program does have a routine for deleting an employee who has left the company.

The employee data must remain in the program until the end of the tax year, when it can be deleted and the vacant file used for another employee.

It is impossible to access the program without the correct password. This can be changed when required. A dongle is also provided.

Payroll Plus

Landsoft have two available payroll programs, Payroll Plus being the original program and less sophisticated than its big brother Payroll 2.

Written to Inland Revenue specifications for computerised payrolls, it covers all tax codes and all NI codes. Hourly, weekly and monthly paid staff can be mixed on the same file disk in any order.

Three rates of overtime are covered, either as a percentage of the basic hourly rate or as an amount. It offers five pre-tax and five after-tax adjustments, of which two of each can be pre-set to avoid the necessity of re-entering each payday.

Access to data for manipulation is under a security password or code which can be changed when required. All employee data is easy to change.

Four choices of payroll run are offered: payslip printed out after each entry; all entries made first and then a continuous print run, immediate payslip print run without entries; or selection of individual employees. Payslip and copy are produced side by side. Analysis after payrun is provided in each of up to 26 groups or departments, including the amount the employment has actually cost, total overtime, overall tax, NI, etc., and also a note and coin analysis.

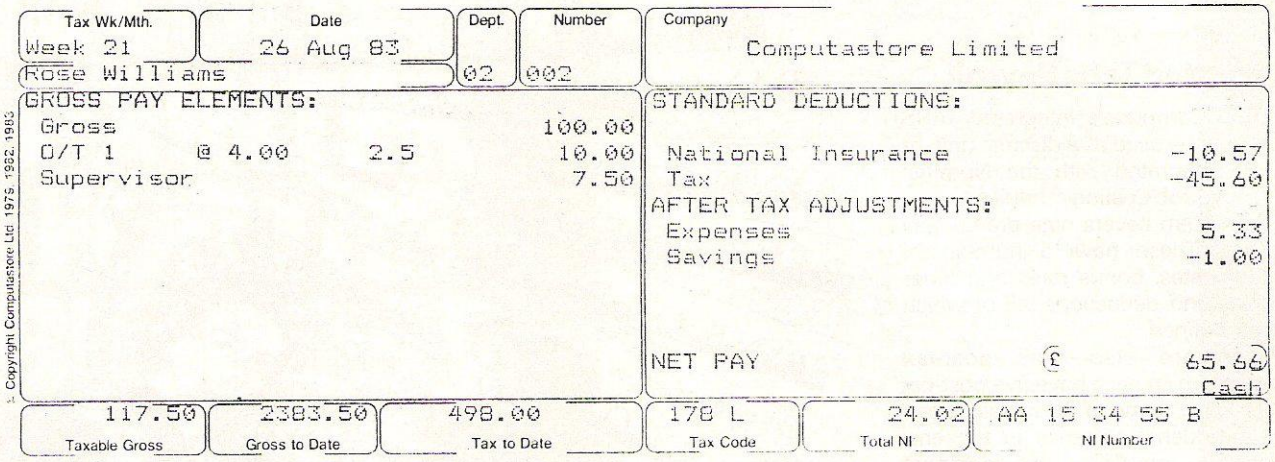
P35 listings can be provided. At the end of the year totals can be automatically zeroed ready for the new tax year.

Landsoft offers an Update Service at a cost of £25 plus VAT a year. Whenever legislation requires, an updated program disk is dispatched which also includes any program improvements that may have been introduced.

Big brother to Landsoft's Payroll Plus program, Payroll 2 offers extra features while retaining the simplicity of operation of the original program.

Again the program covers all tax codes and all NI table letters. Hourly, weekly and monthly paid staff are mixed on the same disk. Three rates of overtime can be set by the user.

Four of the five pre-tax adjustments (including SSP) can be pre-set, while all five after-tax adjustments can be pre-set if required. Tax code changes can be globally changed.



Tax Wk/Mth.	Date	Dept.	Number	Company
Week 21	26 Aug 83			Computastore Limited
Rose Williams		02	002	

GROSS PAY ELEMENTS:

Gross			100.00
O/T 1	@ 4.00	2.5	10.00
Supervisor			7.50

STANDARD DEDUCTIONS:

National Insurance	-10.57
Tax	-45.60

AFTER TAX ADJUSTMENTS:

Expenses	5.33
Savings	-1.00

NET PAY £ 65.66 Cash

Taxable Gross	Gross to Date	Tax to Date	Tax Code	Total NI	NI Number
117.50	2383.50	498.00	178 L	24.02	AA 15 34 55 B

© Copyright Computastore Ltd 1979, 1982, 1983

Computastore's payslip lists each item which makes up an employee's wages.

SSP is calculated and printed on each payslip copy. The SSP paid total is held and overall totals for the year to date. Access to employee data is under a password and entry of data is to a very high degree of validation.

A choice of payroll run methods offers entries made and then continuous print out; immediate print run without entries; or the selection of individual employees. Payrun produces plain or pre-printed payslips.

Payrun analyses after each print run are provided in up to 26 different groups, which can be combined with other analyses to produce a final combined analysis.

Giro slips and cheques can be printed automatically, but if the user prefers to write cheques manually, the schedule makes the job easier.

P14, P60 and P35 listings are obtainable and at the end of the year grand totals and individual employee totals can be globally zeroed.

The system also incorporates an interrupt system whereby the computer can be used for other purposes before returning to the point of close down to continue entering. Landsoft's Update Service is also offered for Payroll 2.

Sky Software Multi-user Payroll

Sky Software, which has recently changed its name from Comsoft Associates, offers a multi-user management accounting package including a payroll program which can be operated on its own or as part of the package.

It is designed to make payroll runs as easy as possible, but provides facilities for complicated pay structures and full manual intervention if necessary.

There is no limit to the number of employees and up to 21 rates of pay and standard adjustments are covered, plus 12 occasional adjustments.

Weekly, four-weekly and monthly paid staff may be held on the same disk and sub-contract staff are catered for. Tax codes are easily updated and SSP is calculated. P60 and P45 information can be printed, and all prints may be restarted or reprinted.

Holiday pay and holiday stamp schemes are also catered for, as are any retention monies.

Correction of payment is allowed, with reports corrected for reprint after error correction. A control list is produced for checking payments before pay slips are printed.

Payment can be made by credit transfer, with a credit transfer list printed. Cheques can be printed and if paying in cash, the payroll provides a coin analysis.

A departmental analysis of costs can be produced and the whole system has password protection.

Pegasus Business Software Payroll

Pegasus Business Software's accounting system enters 1984 as one of the UK's top selling systems. It includes a payroll module which will operate alone or as part of a totally integrated accounting system.

With the Pegasus payroll system, the user designs his own payslip. It caters for up to 17 user-defined payment types and up to 17 deduction types, also user-defined. Statutory Sick Pay is catered for by this payroll system. If an employer pays staff by cash, a coin analysis is provided indicating the notes and coins required for each wage packet.

Payslips, Giros, cheques and employee's record cards may be printed at any time either for the whole file, a single employee, or a range of employees. End-of-year forms, P60's and P35's are all provided at the end of the year. Full departmental analyses are available and also an overall company analysis.

Up to 500 employees can be entered onto one disk. Employees may be removed from the file at any time, but their details will be retained until year end for statutory reports.

Pegasus' payroll module can be integrated with the nominal ledger and job costing. In this instance, any data entered onto the payroll program will automatically update related information in another module.

SPECTRUM PAYROLL 8000

Spectrum's Payroll 8000 system is part of a comprehensive accounting suite of software. It reflects all Statutory (SSP) and Bank (Giro) regulations.

Up to four pre-set payment amounts per employee are catered for, with up to five hourly rated entries per employee. Up to five pre-set standard deductions for each employee are available, plus an override for 'one-off' bonuses or deductions.

One data disk handles weekly, 2 weekly, 4 weekly and monthly payrolls.

The program automatically calculates PAYE and NI for employee and employer, for all different classification and codes. SSP is also calculated.

Pension contributions can be entered as either a fixed amount or calculated as a percentage of a gross pay or basic pay.

Holiday pay can be paid either for the entire payroll or to selected employees and holiday accruals can be accumulated by an employee as a percentage of a weeks gross pay or as a fixed amount.

Payment can be made by Cash, Bank Giro, Cheque or a mixture of the three. Individual and overall coin analysis is available for cash payment. Payslips, Bank Giro and Giro Schedules, Cheques and statutory Year End Forms are all produced automatically.

Departmental analysis for an overall analysis is also automatically produced. Access to the program is limited to authorised personnel.

Payroll Master

M & M Software is to launch a payroll package very shortly, called the Payroll Master. Four versions of this package will be available – V1 with a 600 file capacity and V2 with a 1800 file capacity, both of which feature manual SSP calculations; V3 with a 140 file capacity and V4 with a 500 file capacity, both featuring automatic SSP calculations.

Designed and written to comply with Inland Revenue Specifications, Payroll Master caters for all Tax Codes and NI codes (including contracted-out). Hourly, weekly and monthly paid staff can feature on the same disk.

There are three overtime rates of pay, and four pre-tax and after-tax adjustments which may be pre-set. SSP is calculated automatically.

Payroll Master provides individual and total cash analysis and cost analysis for up to 26 groups or departments.

Contractors Payroll System

FCG Computer Systems offers a payroll system designed with building contractors in mind. It operates around conventional timesheets, with time worked for each employee entered and labour costs posted to the contract cost ledger.

The system is set up in accordance with National Working Rules to automatically calculate overtime pay, sick pay, travel money, fares allowances, HWP stamp allocation and proportion of GMB. However it does accommodate variations from the NWR.

Individual sub-contractor records contain the expiry date of the C714 certificate and calculate tax at zero or 30% as appropriate. Reminders are produced three weeks in advance of expiry.

There are 26 pay elements, 10 of which can be user-defined, such as pension and court orders. PAYE is calculated and payslips are printed with a complete analysis of the pay make-up. A coin analysis is provided and also a payslip analysis summarising all payslip entries.

For each payroll run, a contract cost analysis shows cumulative and current week costs and hours worked for each trade on each contract. An employee contract analysis lists the time spent by each employee on each contract, plus the resultant cost of his labour.

At the end of the year P35 and P60's are printed out and end of year totals are automatically zeroed (pay, tax, NI, etc). Any updates in rate of pay or tax codes are globally updated.

Weekly payrun totals are printed and also the current and past months Tax and NI deductions detailing both gross (including SSP) and nett NI figures (useful for PAYE payments).

Statutory changes in Tax and NI are under user control. Instructions and data are forwarded to each user if required. Any record on file can be viewed, altered, deleted, or printed out at any time. Password protection is available if required.

Bonus

Intex Datalog's Bonus payroll system is menu-driven. Weekly, multi-weekly and monthly paid staff are all on one disk. The payroll can be for one, a range or all employees. Calculations can be reversed and the payroll re-run for selected employees.

SSP is calculated and an extra SSP module determines eligibility and calculates sick pay even in complicated cases. When tax codes change, the relevant data has to be entered just once and each employee's code number is automatically amended.

Changes in tax rates necessitate changes in the program itself. When changes are due, Intex Datalog provide a program which automatically updates the payroll disk. Holidays are payable in advance either by allocation of hours or accrual.

BONUS has 20 company additions/deductions before/after tax – 10 per employee. These can be standard if required. Eleven overtime rates can be catered for, five per employee. It also has a piece-work facility. Pay rounding and cash analysis is optional and Giro and cheques can be printed.

Monthly and year-end summaries are provided and end-of-year forms are printed out. Departmental analyses are also provided. BONUS Print formats can be designed by the year. has a two-level password protection and the program will not operate without a security key being fitted to the computer.

Product survey data

Product: Spectrum Payroll 8000
Manufacturer/Supplier Spectrum Business Services, PO Box 199, Spectrum House, 27 East Parade, Bradford, West Yorkshire BD1 15R. Telephone 0274 308188.
Price: £300
Comments: Available on diskette as part of accounting suite.

Product: Payroll Master
Manufacturer/Supplier: M & M Software, Wych Elm House, The High, Harlow, Essex. Telephone 0279 39576
Price: £150-300 depending on version required
Comments: Separate program on diskette

Product: BONUS
Manufacturer/Supplier: Intex Datalog, Eaglescliffe Industrial Estate, Stockton-on-Tees, Cleveland TS16 0PN. Telephone 0642 781193
Price: £400 plus VAT
Comments: Separate program on diskette

Product: FCG Contractors Payroll
Manufacturer/Supplier: FCG Computer Systems, Hamilton House, Mabledon Place, London WC1H 9BD. Telephone 01-388 7345
Price: £1100
Comments: Separate hard disk program. Diskette version also available

Product: Payroll Plus
Manufacturer/Supplier: Landsoft, 28 Sheen Lane, London SW14 8LW. Telephone 01-878 7044
Price: £150 plus VAT
Comments: Separate program on diskette

Product: Payroll 2
Manufacturer/Supplier: Landsoft, 28 Sheen Lane, London SW14 8LW. Telephone 01-878 7044
Price: £375 plus VAT
Comments: Separate program on diskette

Product: Multi-user Payroll
Manufacturer/Supplier: Sky Software, 13 New Road, Bromsgrove, Worcestershire B60 2JG. Telephone 0527 36299
Price: £350 for payroll program, £500 for multi-user package
Comments: Separate program or part of package on hard disk

Product: Pegasus Business Software Payroll
Manufacturer/Supplier: Pegasus Business Software, 20/22 Station Road, Kettering, Northants. Telephone 0536 522822
Price: approximately £350 per module
Comments: Separate module or part of accounting suite on hard disk

Product: Integrated TABS Payroll
Manufacturer/Supplier: Raindrop Computers, 46 Cadogan Lane, London SW1. Telephone 01-235 6286
Price: £250
Comments: Separate module, or integrated into accounting package, on diskette

Product: Integrated Accounts System
Manufacturer/Supplier: Electronics Aids, Mythe Crest, The Mythe, Tewkesbury, Gloucestershire GL20 6EB. Telephone 0684 294003
Price: £400 plus VAT
Comments: Part of accounts package on diskette

Product: Officemate
Manufacturer/Supplier: Micro Computer Centre, 28 Sheen Lane, London SW14. Telephone 01-878 7044
Price: £325 plus VAT
Comments: Payroll module on diskette

Product: Superpay
Manufacturer/Supplier: Computastore, 16 John Dalton Street, Manchester M2 6HG. Telephone 061 832 4761
Price: £395 plus VAT.
Comments: Separate program on diskette

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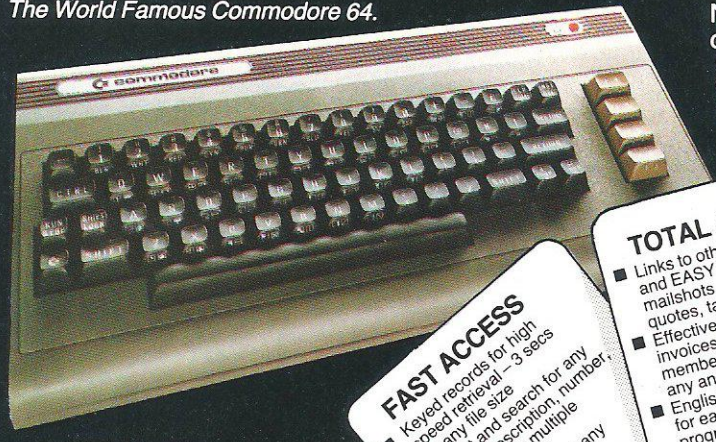

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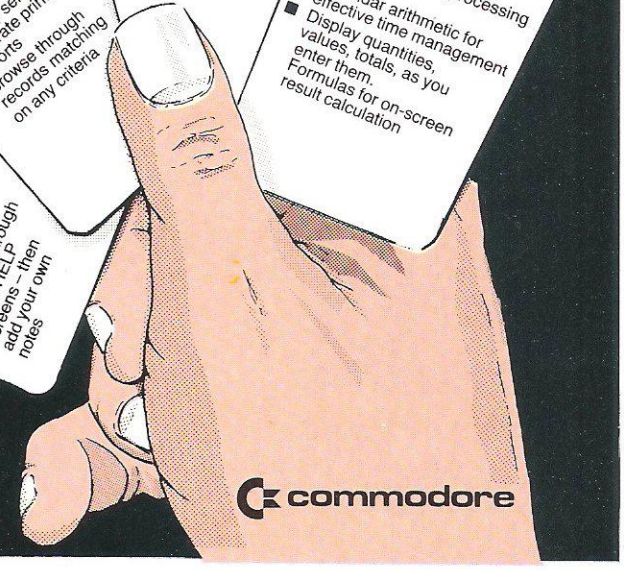

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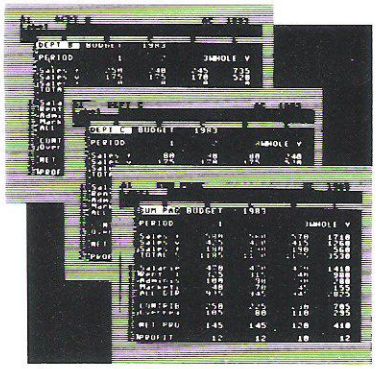

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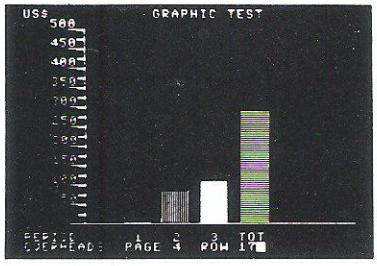

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Commodore's PET

The cost of re-equipping a research laboratory with the latest microprocessor-controlled instrumentation can be astronomical, and, in the University sector at any rate, the necessary finance is not available. However, many older pieces of apparatus can be given a new lease of life by using them with a dedicated on-line microcomputer. Many of the advantages and facilities of a new instrument may, in this way, be obtained at a fraction of the cost. In this article Dr Alan Collins describes some of the areas of research in which Commodore computers are being used in the physics department at King's College London.

The physics research department at King's College London has used Commodore computers to control instruments, and collect and process data, since the PET 2001-8 was first introduced in 1978. This early PET was the first self-contained modestly-priced microcomputer on the British market that gave the user access to the address and data buses.

Two research students at King's College – Ricardo Rodrigues and Peter Siddons (now both PhD's) – developed a memory-mapped interface for the PET 2001, containing two 6522 VIA's and up to 3K of EPROM, which was located in the block 9 address space (see Journal of Physics E (1979), Vol. 12, pp.403-408). This interface, which is also suitable for the CBM 3000 and 4000 series computers, is configured to provide a 16 bit data bus, an 8 bit control bus and an input and output handshake line.

This permits operating up to 256 different data-handling modules, each capable of working to 16-bit precision. Typical modules are 3, 4 and 8 phase stepper motor drives, 16-bit counter, 12-bit analogue to digital convertor (ADC) and digital to analogue convertor (DAC), mains-synchronised clock and various electro-mechanical devices. Machine-code routines to handle the input and output functions are contained in the on-board EPROM and are selected by a series of USR calls.

Similar hardware, driven from the IEEE port, is now available commercially, but the early impetus given by the Rodrigues-Siddons interface has resulted in five different research groups in the department using Commodore computers to run experiments and process the data.

Machines from the 2000/3000, 4000, 8000 and 9000 series are currently in operation. Some systems still use the original interface while others input and output data via the IEEE bus (GPIB).

A Bus Operating System (BOS) has been developed which allows any apparatus with an IEEE port to be successfully interfaced to the computer and which greatly speeds up data transfers to and from GPIB instruments such as the Commodore disk drive. (For example a 4000 point integer array can be written on the disk in less than seven seconds).

For many applications the processing power of the Commodore machine is adequate, but when substantial "number crunching" is required data files are sent to a PDP 11/44 – and from there to the University of London Computer Centre if necessary. The RS232 link to the PDP 11/44 uses either a NETKIT in the CBM, or the built-in ACIA in a 9000 series PET, driven by our own file-transfer program which uses a check-sum to ensure there are no errors. Alternatively data can be transmitted using a Small Systems Engineering IEEE to RS232 convertor.

Experiments

In almost every experiment the results are finally summarised as a "spectrum" or graph in which one variable is plotted against another. The related variables may be X-ray intensity and angle, transmission and wavelength, electron energy and voltage, signal amplitude and time, and so on. Brief details of the way the microcomputers are used in these investigations are given below.

X-ray diffraction

When a suitably cut crystal is placed in a narrow beam of X-rays, the X-rays are diffracted in directions which depend on the structure of the crystal, the wavelength of the X-rays and the angle between the crystal and the incident beam. In a simple experiment the crystal is mounted on a platform which can be rotated by a stepper motor and the diffracted X-ray beam is detected by a stationary geiger counter.

The number of counts from the geiger counter, recorded in a fixed time interval, will depend on the angle between the crystal and the X-ray beam. The experiment can be completely automated by registering the pulses from the geiger tube on a 16-bit counter and driving the stepper motor, both by means of the interface described earlier.

After a fixed time interval controlled by the computer the reading from the counter is transferred to memory, the counter is reset to zero, pulses are fed to the stepper motor to rotate the crystal slightly and the sequence restarted. At the end of the experiment the array of numbers stored in the computer can be processed to show a graph of diffracted X-ray intensity as a function of angle. Hard-copy is produced on a Hewlett-Packard plotter connected to the IEEE port.

Silicon

More sophisticated X-ray diffraction studies use single crystals of silicon which act as X-ray interferometers. Some of these crystals must be cut to very elaborate shapes. This is carried out by moving the sample in three perpendicular directions using a micro-positioner fitted with three stepper

fit for King's

motors driven by the computer, and grinding the silicon away with a dental drill. Many samples of great complexity can be reliably and reproducibly fabricated by this technique.

Optical absorption

A great deal can be learned about processes in crystals from the wavelengths at which the material absorbs light. For wavelengths to which the eye is sensitive this absorption affects the colour observed, but important information is also obtained from studies in the ultraviolet and infrared regions.

A spectrum can be produced by using a monochromator in which the incoming light is split up into different wavelengths with a diffraction grating. When the grating is rotated, the different wavelengths fall in turn on a detector which produces an analogue signal proportional to the intensity of the light at that wavelength.

For computer operation the signal from the detector is read by a 12-bit ADC and the grating is either rotated by a stepper motor driven from the interface, or by a synchronomous motor, in which case data transfers are timed with the mains-synchronised clock. The first method allows repetitive scanning to be carried out which is useful in some applications.

Initially an incident-light spectrum is recorded with no sample present and the 3000 to 4000 12-bit numbers are stored in memory. After inserting the sample the transmission spectrum is recorded over the same wavelength range. At each point the absorbance is calculated by taking the LOG of the ratio of the two spectra and, after scaling, is plotted against wavelength on an X-Y plotter, using a two-channel 12-bit DAC.

Software for the plotter, including a vector generator and generation of a limited number of symbols, is contained in an EPROM. The final spectrum can be stored in a few seconds on floppy disk, for future reference.

The use of the Commodore 3000 in this application has greatly speeded up what used to be a tedious manual analysis of analogue chart recorder output, and many hundreds of spectra have been obtained in this way.

Fourier-transform spectroscopy

Another method used to obtain optical absorption spectra, particularly in the infrared spectral region, uses an interferometer rather than a monochromator. In the interferometer the incoming light is split into two beams, then these two beams are recombined at the detector, using a system of mirrors.

When one of the mirrors in one beam is moved at a slow steady rate, in a direction perpendicular to the beam, the signal from the detector, plotted against time, is a series of fringes. The absorption spectrum can be calculated from this fringe pattern using a mathematical technique known as Fourier transformation.

Using a commercially available ROM (from Structured Software) which carries out a fast Fourier transform (FFT), absorption spectra can now be obtained, plotted out on a Commodore printer, in a few minutes. As in other applications the analogue signal from the detector is sampled using a 12-bit ADC, and between each reading the mirror is moved using a stepper motor driving a precision lead screw.

This on-line analysis has completely replaced the earlier procedure in which data on punched paper tape was processed by the University of London Computer Centre.

Radio wave propagation

The FFT technique is also used in a CBM-controlled system dedicated to an analysis of "atmospherics". For a short-wave listener atmospherics are the annoying clicks and crackles which interfere with the station of interest. However, from a Fourier analysis of the waveform of an atmospheric, which shows how the signal varies with frequency, a great deal can be learned about the electrically active layers in the Earth's ionosphere, and how these influence the propagation of radio waves. (Without these layers, long distance radio communication would not be possible).

To carry out the analysis three signals derived from the atmospheric are digitized and stored in a three channel × 1024 word Datalab Transient Recorder. These data are then transferred to the CBM and, after preliminary signal processing, waveforms are sent to a Hewlett-Packard spectrum analyser which obtains spectra using a hard-wired FFT.

These spectra are returned to the CBM for final processing, and parameters calculated are output to a CBM printer, a Christie digital cassette and a CBM disk drive. All data transfers are via the GPIB.

Photo-electron spectroscopy

When a gas molecule is illuminated with very short wavelength ultraviolet light it may be ionized, giving out an electron. The energy of this electron is well defined and is characteristic of the molecule being investigated.

To measure the electron energy the electron is made to follow a curved path between two curved metal plates which have a voltage difference between them. If the voltage between the deflector plates is correct the electron will reach a detector. This is an electron multiplier (or channeltron), and after amplification the signal from the channeltron is converted into an analogue voltage proportional to the number of electrons collected per second.

In the spectrometer controlled by a PET this analogue voltage is digitized by a CIL microsystems PUPI interface. The interface also generates the scan voltage for the spectrometer deflector plates, and the digitized photoelectron signal is stored at fixed intervals of the scan voltage. At the end of the scan the energy of the electron can easily be determined from the array of stored data.

The computer-controlled digitally-generated scan voltage is very much more flexible than the electronically-derived ramps used previously, and the storage of the spectra on disk allows the data to be processed in more detail after the experiments have been completed.

In conclusion, Commodore computers are used to control experiments and collect and analyse data in the physics research department at King's College London. The computers either use an interface designed here, or commercial interfaces or other equipment connected to the IEEE port. These dedicated on-line computers have greatly increased the speed and convenience with which our results can be obtained.

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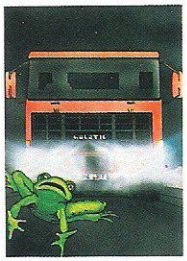

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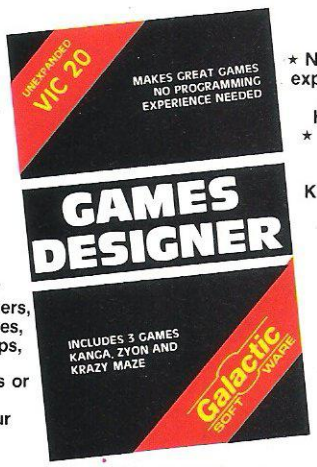
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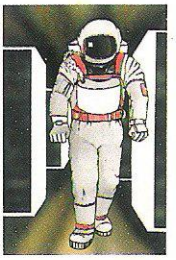

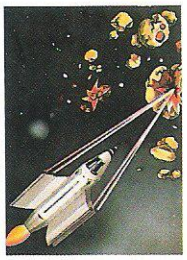

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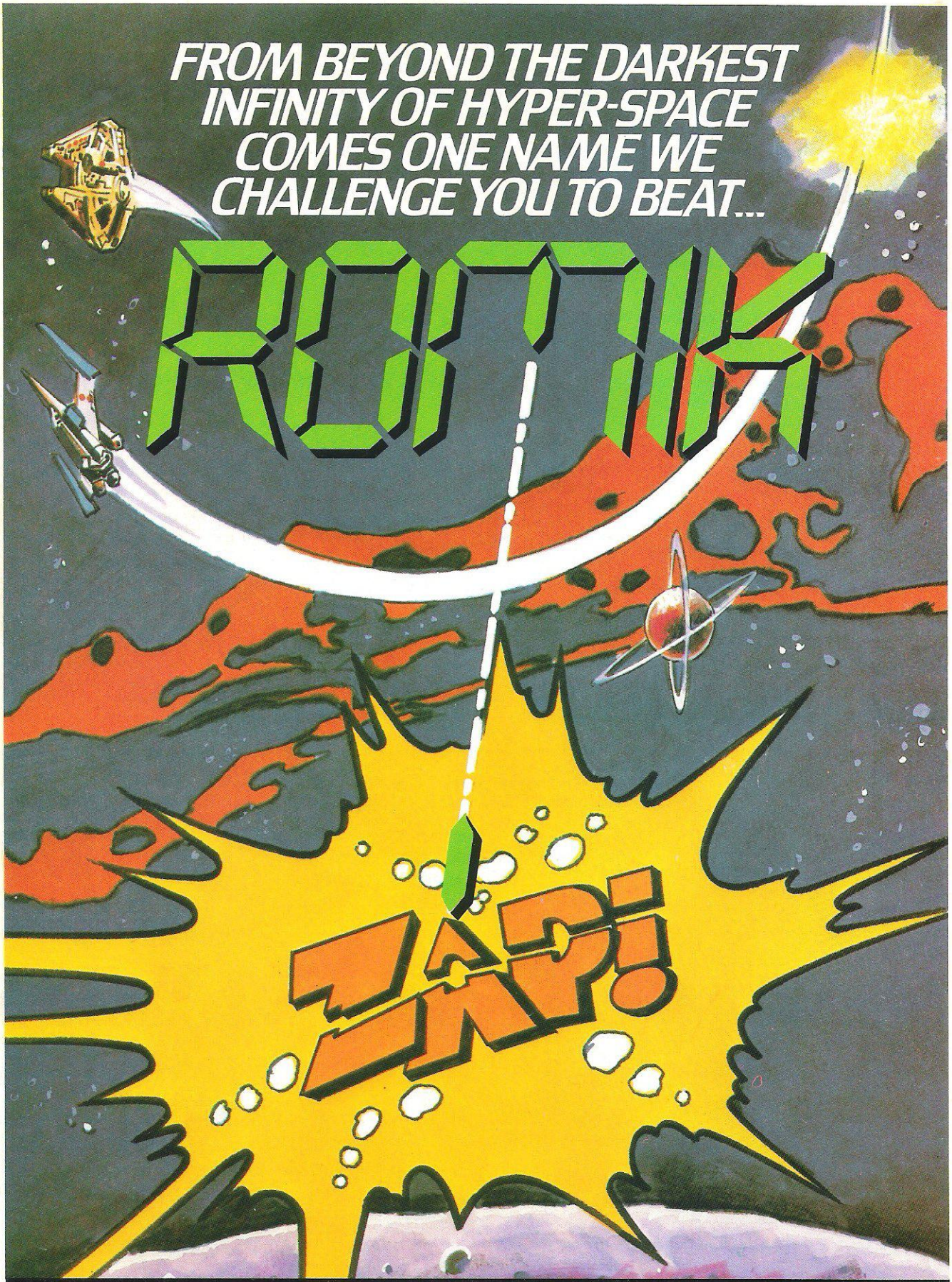

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